THE

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THE ECONOMICAL EFFECT OF LIVE STEAM FEED HEATING.

IT seems to be accepted as an experimentally proved fact that the heating of feed water by live steam is productive of great economy. Several reasons are assigned for this. One is that the thermo-dynamic availability of the furnace heat transmitted to the water at a point nearer to the furnace temperature raises the efficiency of such heat. We look doubtfully on this explanation. Another reason is that the general circulation in the boiler is improved. If all the water in a boiler is at the full temperature of the steam space, as it would be if the feed were put in at that temperature, the application of further heat at any point would instantaneously cause steam to rise from that spot, and the water would nowhere be dull and sluggish, but would sweep freely over the plates and keep them cool. It is also offered as an explanation that when the boiler plates are hot there is less refraction of the heat passing through from the fire to the water side, and that it is possible we are all in error in thinking that heat transmission is the more rapid according as it traverses a medium interposed between bodies having the greatest difference of temperature. Light, we know, travels best in a homogeneous body. Is it not possible that heat also will travel better through a plate which has least difference of temperature in its own substance. In a paper by M. Normand, read at the 36th meeting of the Institute of Naval Architects, the author attributed an economy of 20 per cent. to his system of feed heating. He took the steam from the low-pressure cylinder of compound engines by a special valve, and his explanation of the economy was as follows:—

(*a*) An economy which results from the saving of so many thermal units due to using steam which has already done work in the cylinders. This saving may amount to 10 or even 14 per cent. (*b*) The circulation in the boiler is improved, and the plates kept better swept by the rapid passage of the water. He claims a trebled heat transmission from the same temperature difference. This latter economy would be that found where steam direct from the boiler is used to bring up the feed to a maximum, and it may be at the bottom of the better appreciation of the Lancashire boiler in the North, where economisers are used, than in the South, where they are comparatively rare, for it is very common practice to feed at maximum steam temperature from an economiser, leaving latent heat only to be supplied from the furnace.

In the absence of more data it is not possible to determine how the whole economy of feed heating is brought about. What is wanted are tests of a boiler with and without live steam heated feed water in order to determine two facts.

First, when using the steam are the waste gases reduced in temperature? This would show that the efficiency of heat transmission had been improved, and would prove that

either the plates were more efficient, or had been more copiously watered by the more rapidly circulating water.

Secondly, does the use of steam cause any difference in the chemical composition of the waste furnace gases? It is possible that their temperature might be higher even with increased economy, for the higher temperature might be due to better combustion. If, therefore, with the colder feed an undue proportion of combustibles appeared in the waste gases, it might well be argued that this was due to contact with chilled plates. It has been shown experimentally that in contact with cold plates there is a stratum of unconsumed gas which cannot ignite, because of being cooled below ignition point. This implies waste. Mr. Thos. Fletcher, the manufacturer of gas apparatus, has shown that better results can be obtained with boiling vessels over gas flames when the bottom of the pot is studded with short projections, not so much that these afford a greater area, as that they get a little hotter than the water-cooled bottom, and do not extinguish flame. The combustible gases are thus enabled to complete their combustion. Until it is known by experimental determination how the use of live steam for feed heating affects the above conditions, the reasons for the economy which results must remain speculative.

The method of M. Normand of abstracting steam at mid-stroke from the low pressure cylinder, or in triple and quadruple expansion engines from the low pressure casing, seems well calculated to produce economy. Such removal will only slightly affect the mean pressure in the final cylinder, for it will doubtless reduce the back pressure, and if suitably arranged to abstract any collected water, may prevent some re-evaporation during the exhaust stroke, and serve to reduce the range of cylinder temperature, or the amount of its internal surface cooled by such re-evaporative effects. With every pound of steam so abstracted will be taken 966 heat units that would otherwise go to the condenser. In the compound engine, its abstraction at mid-stroke will be of very little moment on the score of power, while the less favourable point of abstraction in triple engines will matter little, because of the smaller relative value of the final cylinder.

In large boilers which are apt to contain a good deal of dead water in their lower parts—a fault that the water-tube and under-fired shell boilers do not possess—an injector or water propeller might be arranged to draw water from the bottom of the boiler and deliver it at the water surface, so as to draw down hot water to the boiler bottom. It was with this object that internally fired boilers were fitted with cross pipes in the tubes. These, however, defeat their object, and some positive means for circulation should be adopted in these boilers.

Professional Amenities.

THERE once was a time, within the memory of living man, when the announcement of any great scientific discovery was hailed with satisfaction throughout the civilised world, and the congratulations due to the man who had added to our knowledge was freely and cordially given by his co-workers in the domain of science, without any of the heart-burnings and petty jealousies which are so prevalent in these degenerate days. We have only to instance the recent achievement of Prof. Dewar as an example of the strained relations which now so frequently exist amongst scientific men. Prof. Dewar has been striving for years to liquefy hydrogen, and only a week or so ago he brought his labours to a completely successful issue. This wonder of modern chemistry is barely announced when a rival chemist, on the strength of a private letter from Cracow, combats Prof. Dewar's claims to priority and awards to Prof. Olszewski the distinction of being the first to liquefy hydrogen. This letter, said to have been written in 1895, Prof. Ramsay was challenged to produce, but apparently it was not forthcoming. This is all the more to be regretted, as it is apparently quite at variance with one of the latest publications of Olszewski, wherein he confesses his failure to accomplish what Prof. Dewar has succeeded in performing. Whatever doubt may exist as to the rival claims of the two great chemists should be set at rest by a letter in the *Pall Mall Gazette* of last Tuesday under the *nom de plume* of "One Who Knows," and the report on page 6 of Wednesday's *Times* of a paper read before the Paris Academy of Sciences on the 16th inst. This is not the first time we have felt it incumbent upon us to draw attention to the disparagement of Prof. Dewar's brilliant achievements which has been assiduously carried on in certain quarters for a considerable period, and it is now to be hoped that a better feeling may prevail in the divided ranks of the chemists, for it cannot be said that the controversy has been carried on in a manner which reflects much credit on one side at least. The peace on earth and goodwill towards men kind of spirit which seemed to prevail in Faraday's time appears to have lain dormant ever since, if it has not been wholly swept away in these days of high pressure and self-interest.

Lightning Arresters for High Tension Circuits.—The *Engineer* (New York) of April 1st prints a long illustrated article from Mr. Alexander J. Wurts on experiments with lightning arresters for high tension circuits. These arresters are intended to provide, at intervals along the distribution mains, spark gaps between the conductors of the system of low resistance in comparison with the rest of the circuit, and means for breaking the arc formed on the passage of a pilot spark from a lightning flash. They are, of course, quite different from telegraphic lightning arresters. The experiments were directed to testing the resistance of the gaps to sparking, and the rapidity with which the arc was broken after formation by a pilot spark. The discharge from a Leyden battery, excited by an electrical machine, was employed to produce the pilot spark. The resistance to sparking was measured by adjusting another gap in parallel with the arrester until the spark passed indifferently between them, and the spark was produced by shortening another gap in series with the two. The rapidity with which the arc was broken was indicated by the flicker on a bank of incandescent lamps arranged in parallel with the arrester. The occasion of the experiments and the article was to defend the author's (Wurts's) pattern of lightning arrester from the competition of another brought out under the name of Wirt's, and a third design was tested at the same time. The interest to us lies not in the commercial reputations of these arresters, but in the clear way in which the non-arcing quality of zinc alloys is brought out in the experiments, so that no arc can be maintained under an alternating pressure between such substances. The dimensions of the two parts between which, by a pilot spark, the discharge is started, seem to matter little, so long as they are made of a non-arcing alloy, and it appears that in no case where these materials are used does the discharge last beyond the time when, in the cycle of alternation, the current falls to zero. It is generally understood that alternating currents are more readily interrupted than direct currents, and the experiments, we gather, do not bear on the latter, arcs from which are generally dealt with by a magnetic blow out.

ELECTRIC LIGHTING AT WIMBLEDON.

It is now about 14 years since a series of experiments in street lighting by electricity was carried out at Wimbledon under the supervision of Mr. W. H. Preece; but, notwithstanding this early start, and the fact that a license was obtained as long ago as 1890, and a scheme prepared by Mr. Preece and Mr. Kapp, Wimbledon cannot yet be numbered amongst the towns which enjoy the benefit of an electric light supply. The local authorities do not, however, intend that this state of affairs should continue, and they have now obtained a provisional order, and have entered into contracts for the carrying out of a scheme prepared by Mr. A. H. Preece, and hope that, in the course of next year, they will be ready to supply current for public and private lighting. As the undertaking will be started under conditions which differ considerably from those which generally obtain, owing to the fact that 80 per cent. of the estimated output will be utilised for public lighting, we propose to give a few particulars of the scheme, for which we are indebted to the paper which was recently read by Mr. A. H. Preece before the Association of Municipal and County Engineers.

The streets of Wimbledon have for some years been lighted by oil lamps of about 20 candle-power each, of which there are at present about 800 in use. It is now proposed to use incandescent lamps of 32 candle-power, each oil lamp being replaced by one, or, in some of the more important thoroughfares, by two or more incandescent lamps; and for this street lighting about 900 lamps will be required. In addition to the public lighting, the scheme provides plant for the equivalent of 6,000 8-C.P. lamps for private lighting, and it is estimated that there will probably be 5,000 lamps connected in the course of the first 12 months' working. Owing to the large area to be covered, a high pressure alternating current system has been adopted, current being generated at 2,200 volts, and transmitted to transformers placed in underground chambers, whence it will be distributed by a three-wire system of mains with 400 volts across the outer conductors.

The generating plant will consist of three Crompton 120 kilowatt alternators and exciters direct coupled to Willans engines, for which a combined efficiency of 80 per cent. and a steam consumption of 28½ lbs. per kilowatt-hour have been guaranteed. Steam will be supplied by three Babcock and Wilcock boilers, each capable of evaporating 5,000 lbs. of water per hour; and to these is to be added a dust destructor plant, from which it is hoped to obtained sufficient steam to supply the requirements during the daytime, and perhaps after midnight, not only of the electricity works, but also of the adjacent pumping station. The high pressure mains will be concentric lead-covered cables, drawn into earthenware pipes, the outer of the concentric being earthed at the station. There will be three high pressure feeders terminating at distributing centres, which will also be interconnected by heavy mains, so as to allow of any feeder being thrown out of service without interrupting the supply. From these centres will branch out other and smaller high pressure mains or sub-feeders, which will transmit the current to the transformer stations, provision being made for separate sub-feeders and transformers for the public lighting, so that the street lamps can be switched on or off from the distributing centres without interfering with the private lighting. Although this arrangement will entail an extra expenditure on mains and transformers, great benefit should be derived from the concentration of all switching gear at the three distributing points, and from the greater efficiency of distribution, due to the fact that the transformers for public lighting will not be in circuit except when they are working at their normal full load output.

Provision will also be made for separate low pressure distributing mains for public and private lighting, the public lamps being arranged in circuits of from five to ten lamps each. Two different systems of laying these mains will be employed, according to the nature of the probable demand for private lighting, and to the class of pavement under which the mains are to be laid. When the demand for private lighting is uncertain, and the pavement is of such kind as to make it expensive to open up and make good, pipes will be laid down into which cables can be drawn as required; but when the demand for private lighting is certain, armoured cables will be laid direct in the ground; and the same plan will be followed under gravel pathways even when the demand for private lighting is so doubtful, then only public mains will be laid in the first instance.

As it will be necessary to lay mains in practically every street for the public lighting, the cost of mains, transformers, and public lamp connections forms an unusually large proportion of the total expenditure; this item being estimated to cost over £18,000 out of a total, including buildings and contingencies, of £32,000; whilst the estimated cost of the station plant is only £8,500, or less than half that of the distributing plant. The cost of this latter undoubtedly forms a very heavy charge, but it is stated that provision has to be made for about 40 miles of street, requiring 15 miles of high pressure and 50 miles of low pressure mains, besides some 20 miles of pipes. With regard to output and cost of production, Mr. Preece estimates that there will be an annual output of 300,000 units, of which about 80 per cent. will be required for the street lamps; and that owing to the regularity of the output due to the relative importance of the street lighting, the total cost of production will not exceed 2d. per unit, making £2,500, or a total expenditure, including interest and sinking fund, of £4,200 per annum. Owing to the profit to be derived from private lighting at 6d. per unit, it is estimated that the actual cost to the local authority of the 900 32-candle-power lamps will be only £2,450 per annum as against the present cost of £2,000 for the 800 oil lamps, or an increase of less than 25 per cent. for nearly double the amount of light; and that probably by the end of the second year the revenue from private lighting will have increased sufficiently to make the charge for the street lamps no more than it is at present.

THE ROYAL SOCIETY CONVERSAZIONE.

The usual exhibition of scientific novelties took place at Burlington House on Wednesday, 11th inst., when the first of the Royal Society's two annual conversaziones came off.

Among the scientific questions in the air at the present time, wireless telegraphy takes a first place. This was represented by a working installation of Lodge's system exhibited by Dr. Alex. Muirhead and Prof. Lodge. Telegraphic messages were being sent by this apparatus over the longest clear range obtainable in the Royal Society's rooms, for the electric waves, though they can penetrate through a moderate thickness of more solid substances, prefer, like the waves of light, to pass through air. Lodge's apparatus, of which a short description has already been given in the Electrical Review, Vol. 42, p. 103, consists of two fan-shaped sheets of copper connected at their apices by a coil consisting of a few turns of thick wire. The electric impulses are imparted to this system by sparks passing across air-gaps of about ¾ inch near the centres of the copper sheets. The sparks are obtained from an induction coil, the current of which is controlled by the punched ribbon of an automatic transmitting telegraph instrument. The receiver is exactly similar to the transmitter, but in this latter a coherer and syphon recorder are connected (in the same circuit) in shunt with the coil connecting the sheets of copper. The coherer used was of the very simple form first devised by Prof. Lodge, in which the end of a flat steel spring is pressed against an adjustable steel point—a kind of microphone sensitive to electric instead of sound waves. The telephone may be used as a receiver instead of the siphon recorder, in which case no tapper is required for the coherer, and a much higher speed of telegraphy is possible. The greatest distance over which Prof. Lodge has telegraphed with his apparatus is about 1 mile, and at that distance no falling off in its action was observable.

For wireless telegraphy at very long distances, however, Lodge prefers his system of "magnetic space telegraphy." The apparatus for this system was shown in the secretario room downstairs. The system depends on the mutual magnetic induction of two coils placed at distant points on the earth's surface. The discharge of a condenser or Leyden round a large wire coil sets up an alternating magnetic field, which excites induced currents in another distant condenser circuit tuned to the same frequency, causing the second

Leyden either to overflow into a coherer, or to disturb a Rutherford detector or a telephone, so as to give a signal. The detector shown was a special series of small free coils and granular microphones, each coil in a permanent magnetic field, and so connected to the microphone of the next, that a very feeble alternating current in the first of the series is able to make a telephone in the last emit a loud sound, or through a Langdon-Davies relay, to ring an electric bell and work a Morse sounder. A tone-telephone was also shown, which acted as a highly syntonised call. This highly sensitive receiver for magnetic oscillations had an extraordinary peculiarity, which Dr. Lodge described as "talking to itself." When two of its coils were placed relatively to each other, so that their mutual induction was large, the one starts automatically to act on the other, and the telephone begins to sound.

Mr. Mackenzie Davidson exhibited his apparatus for finding the true position of foreign bodies in objects photographed by the Röntgen rays. This has already been described in the ELECTRICAL REVIEW. He also exhibited a Wheatstone reflecting stereoscope for looking at Röntgen photographs.

Mr. A. A. Campbell Swinton had a very interesting exhibit illustrating his recent discoveries in the discharge in vacuum tubes. Radiometer mill wheels were employed to detect the direction and velocity of the gaseous streams, and the experiments indicated that in very highly-exhausted tubes of the focus type, in addition to the well known negative stream from the cathode, discovered by Crookes, there existed also a positively electrified stream from the anode, which travelled in the opposite direction to the cathode stream and exterior to the latter. A pinhole Röntgen ray camera was also exhibited by Mr. Swinton, with which he had taken photographs of the active area on the anti-cathode, which corresponded with the results he had already obtained on cathode discs. Lastly, though not least interesting, were Mr. Swinton's cathode ray lamps. Two concave cathode discs focus on a cube of refractory material, and give out sufficient light to illuminate a small room. The efficiency of this method of producing light is considered to be quite equal if not greater than that of the arc light.

Mr. Killingworth Hedges exhibited specimens of copper deposited by a process invented by Mr. J. C. Graham. Mr. Graham by mechanical means causes a circulation of the electrolyte over the surface of the cathode. By this device he claims that he can use 10 times the density of current hitherto employed, and yet obtain a more homogeneous deposit.

Prof. Ewing exhibited his new magnetic balance for permeability tests of iron. This apparatus has been designed to afford an easy means of judging of the magnetic quality of iron or steel with special reference to its suitability for use in dynamo magnets. The specimen to be tested is in the form of a turned rod, which lies across the poles of an electro-magnet excited by a constant current. One side of the rod touches both poles, and the force required to pull it away from one pole is measured, the contact with the other pole serving as a hinge. The force is measured by means of a weight which slides along a graduated scale-beam, and the beam is graduated to give, by direct reading, the value of the magnetic induction, B, which would be produced in the tested samples by a constant magnetising force, H. The constant magnetising force selected for the purpose of the test is 20 C.G.S. units, that being a sufficiently strong force to exhibit the quality of different specimens in respect of permeability under strong magnetisation.

Prof. Callendar exhibited electrical recording apparatus. This apparatus is capable of recording almost any kind of electrical quantity directly, and can be made to record other quantities indirectly, as, for instance, temperature by means of the variation of electrical resistance. It has been in use for more than a year at McGill College, Montreal. A brief mention of the apparatus, with illustrations of some of the results obtained, was communicated to the Royal Society of Canada at their last year's meeting in June, 1897, and has been published in their *Transactions*. The principle upon which the apparatus works is extremely simple. A pen or planimeter is attached to the contact point on a "slide-wire," and is kept automatically at the balance point by means of a delicate relay, controlling a pair of clock motors. The co-ordinates of the record are consequently rectangular, and the scale is one of equal parts in the majority of cases. The following are some of the special cases to which the apparatus has been applied:—Electrical records; resistance, voltage, current, and power; temperature records by thermo-couple, or by platinum thermometer; records of sunshine and humidity; cycle records; steam temperature cycles in the cylinder of a working steam engine; forms of alternating current and potential waves.

Mr. C. Orme Bastian exhibited an electric current meter acting by electrolysis, the ampere-hours being measured by the decrease of a column of the electrolyte (dilute H_2SO_4).

Mr. Wimshurst exhibited a Röntgen tube-holder, designed to prevent leakage in the leads, and showed experiments, in which the direction of the electrical discharge was indicated by small fans.

AN AUTOMATIC TELEPHONE EXCHANGE.

MANY and varied attempts have been made to evolve a system of reliably effecting inter-communication between the circuits of a number of telephone subscribers concentrated at one central point or exchange without the aid of an operator at that place. The problem presents difficulties which have not hitherto been successfully overcome, but a system recently developed, and now being exhibited by the

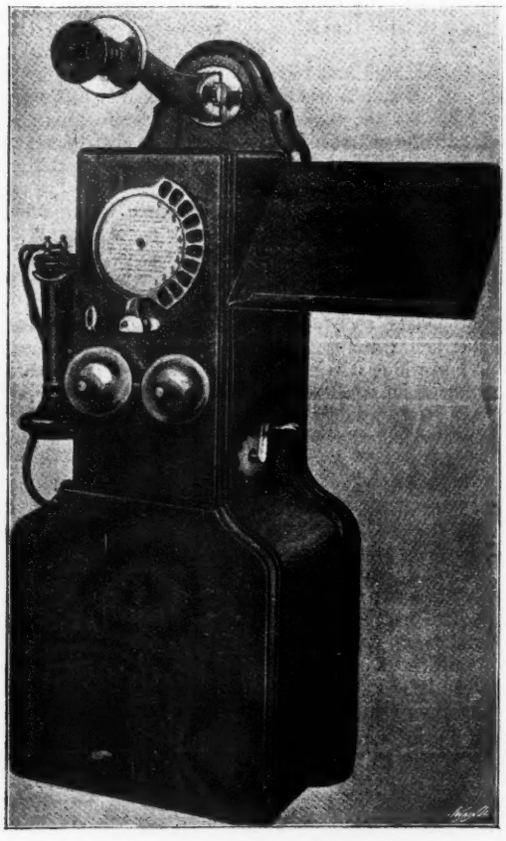


FIG. 1.

Direct Telephone Exchange Syndicate, Limited, in Hall No. 30, Winchester House, Old Broad Street, London, possesses many features of novelty, and includes a variety of ingenious devices employed to effect the changes necessary to secure independent connection with each subscriber of the exchange. Metallic circuits are employed, and at each subscriber's office a complete set of telephone apparatus is installed. The telephone is provided with an auxiliary key-board or commutator, by the use of which the sequence of the currents necessary to actuate the automatic switching

apparatus at the exchange is determined. The subscriber's instrument is illustrated by fig. 1.

The keyboard, shown on the upper part of the apparatus, is disc-shaped, and revolves around its centre, whence it is connected by means of an axle to the commutator internal to the instrument. The commutator is constructed on the well-known principle usually employed in municipal and other messenger and police call systems, where the operating of the call key winds up a clockwork system, which, during the act of running down, rotates a star or toothed wheel, which determines the number of current impulses generated for each movement of the keyboard. As a preliminary to ringing a correspondent in the usual way, the subscriber originating the call must effect the connection at the exchange between his circuit and that of his correspondent by operating the keyboard of his apparatus. This is effected by inserting the tip of the finger into a hole in the keyboard (seen in the figure) corresponding to the number required, and pulling the keyboard round to the stop, where, on being released, it returns to zero automatically. This operation is repeated for each figure contained in a concrete number representing the subscriber wanted, who is subsequently rung by the magneto-generator in the usual way.

At the exchange each subscriber's circuit terminates on an electro-magnetic switch, illustrated by figs. 2 and 3, which

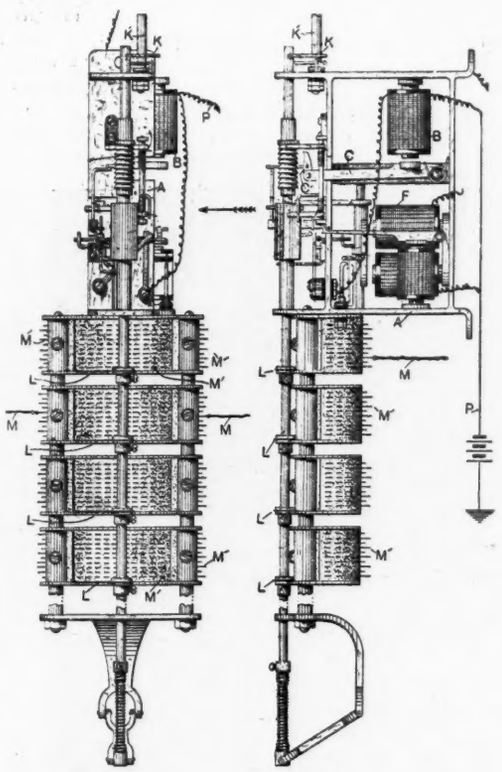


Fig. 2.

Fig. 3.

are a front and side elevation respectively, and where D is a rod movable vertically and circularly. The rod D carries a series of flexible contact arms L which effect connection with the metallic segments of the semi-circular distributors, M'; B is an electro-magnet, the lever C of which raises the rod D to the proper height for bringing the contact arms L into line with the row of segments with which connection is required on the distributors M'. These segments correspond with the multiple jacks of subscribers' circuits connected to ordinary manual boards. F is the motor magnet by whose armature lever the rod D and consequently the contact arms L, are rotated into connection with their proper segments upon the distributors, each segment of which is connected by a cross connecting wire, shown at M, with the corresponding segment of each switch throughout the exchange.

One wire of the metallic circuit may be considered as terminating upon the rod D, whence connection is continued to the segments of the distributors of the other switches, as described above, by means of the stud K', with which a projecting pin, K, on the upper end of D makes contact when the apparatus is at rest in the normal position. The other wire of the circuit is terminated upon an insulated flexible steel spring normally disconnected. When therefore, the rod D is rotated, the pin K is moved away laterally from the stud K', and the segments on the other switches to which this stud is multipled are thus isolated from the subscriber's circuit for the time being. The electro-magnetic switch connected with the circuit of the subscriber who is called is not, however, actuated, and provision has therefore to be made to prevent other subscribers obtaining access to his circuit whilst it is in possession of the correspondent who first called. This is effected by the auxiliary electro-magnet A, brought into use through the medium of a local circuit, and whose armature lever when depressed disconnects the circuit of the contact arms L on the switch of the third subscriber, by which means privacy is secured to the two subscribers who are already in communication. The bottom group of segments on each switch is reserved for connecting up these "non-interfering" local circuits.

A subscriber requiring to communicate with another whose circuit is already engaged, ascertains that he has failed to secure connection by his bell remaining silent when he operates his magneto-generator to call his correspondent. A separate segment is set apart in each subscriber's automatic

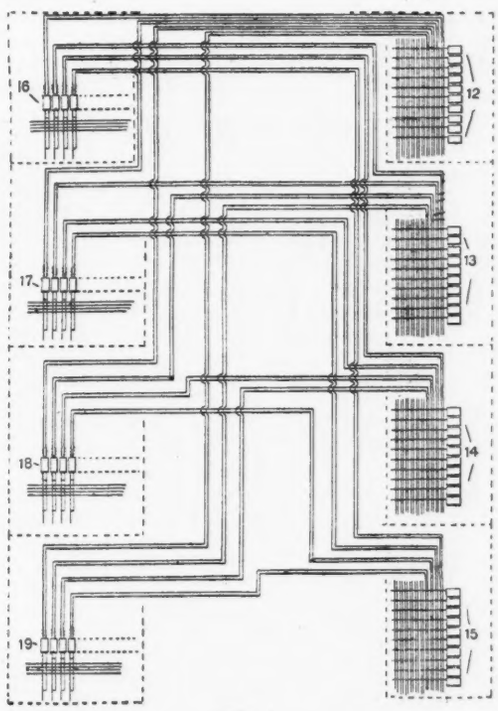


Fig. 4.

switch, to which he may connect his circuit by calling a prearranged number, and speak to the office of the manager of the system if he has reason to suspect that his apparatus is out of order and desires to verify it.

The battery P, which energises the electro-magnets of the switches is located at the exchange, one battery being common to the entire exchange.

To safeguard the apparatus from damage by stray currents from adjacent power circuits with which the telephone wire may get into contact, a "time fuse" is inserted in the wire of each subscriber's circuit connected to the motor magnet. This fuse is shown by fig. 5, where W is a solenoid of wire enclosing an ebonite core, and S S' are flexible springs. The heating effect upon the wire W, of a continuous current, exceeding the current of half an ampere, with which the apparatus is actuated, causes the ebonite core C to expand and raise the spring S, when S' being thus released, flies forward and breaks the circuit of the subscriber, simultaneously

closing the circuit of a local alarm bell in the exchange, which gives warning of the fault. A similar result follows if the subscriber's wire finds accidental earth outside the exchange, when the motor battery P would be discharging continuously. A ready means is provided of locating an open time fuse upon the switchboard.

The act of hanging up the receiver at the subscriber's office after a conversation has terminated, causes a momentary

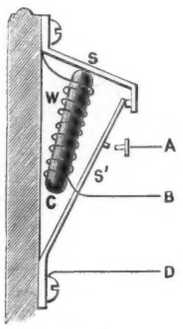


Fig. 5.

current to be sent through the intermediary of the switch arm of the telephone, and this current automatically restores the electro-magnetic switch at the exchange to its normal position.

The switch described is capable of providing for exchanges having a capacity up to 400 subscribers, above which number the combinations of numbers are obtained by allotting two switches to each subscriber's circuit, the first of which selects the groups of hundreds, whilst the second picks out the tens and units in each particular hundred. The principle upon which this sub-division is effected may be understood from fig. 4, where the switches diagramatically represented at 16, 17, 18, and 19 correspond with the first of a pair allotted to select the hundreds, whence the connections continue to the second switch of the pair where the sub-division to the tens and units of the different groups of hundreds is effected. The points of sub-division to the tens and units of the different hundreds are indicated at 12, 13, 14, and 15. This method of effecting combinations of numbers enables 1,000 subscribers to be reached; and by an extension of the principle it is claimed that 10,000 may be accommodated in one exchange.

In the apparatus described the electro-magnets actuating the switches are included in the circuit when conversation is going on, and are consequently given a low ohmic resistance, but in the latest development of the apparatus the "bridging" method of connection is introduced. The system has been in operation about four years, and is employed at some 20 exchanges in various States in America, some of which exchanges are built to a capacity of 1,000 subscribers. It is also in process of installation in a like number of cases at other places, at some of which a capacity up to 5,000 is being provided for.

A view of an exchange equipped to a capacity of 200 subscribers now in operation at Trinidad, Colorado, is shown by fig. 6. Each electro-magnetic switch occupies a lineal space of 12 inches × 4 inches, and projects 6 inches from the supporting base.

It will be gathered from the description that the automatic switch depends primarily upon its mechanical qualities for performing its functions. An exchange equipped with the apparatus must therefore be under the charge of a competent mechanician possessing electrical knowledge, and the accuracy with which the apparatus operates will depend upon the degree of skill with which its necessarily complex mechanism is maintained.

Apart from the central office system, there is a large undeveloped telephonic field within the residential suburban areas of our cities and towns, to the opening up of which the attention of inventors of automatic exchange apparatus has been directed, and where the provision of a reliable and continuous automatic local service with tradesmen and others, giving optional access to the main system would appear to obtain an opening for employment.

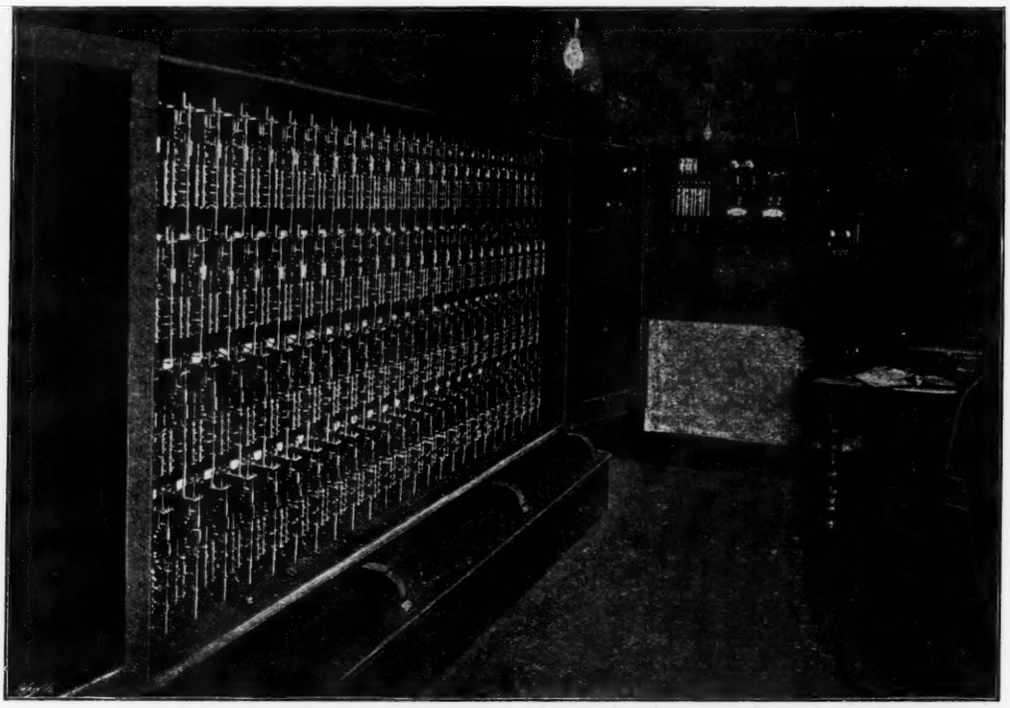


Fig. 6.

The time occupied in operating the automatic exchange is virtually constant for any given combination of figures, and the subscribers are thus relieved by such a system from anxiety regarding preferential treatment by the operators, about which so much has lately been heard, but it is an open question whether, even in its improved state as now exhibited, the automatic switch will prove an efficient substitute for the manual operator, notwithstanding the ingenuity which has been exercised in working out its details.

LITTLE'S CONTINUOUS INTEGRATING STEAM INDICATOR.

THERE has been, we believe, up to the present time no instrument in existence capable of attachment to steam engines, which will automatically produce a record of the power developed during any desired length of run, and which will act in sympathy with any changes either of speed or steam pressure in the cylinder which the load on the crank shaft may demand. With the consent of the proprietors of our contemporary, *Engineering*, we reproduce an engraving of a new type of steam indicator, a full description of the theory and practice of which appeared in the issue of that journal of December 10th last, and this being so we do not propose to give more than a general outline of the aim and construction of this ingenious and handy instrument.

It will be seen from the woodcut that the general appearance of this indicator is similar to that of an indicator constructed to take diagrams as regards the steam cylinder and the drum, but that the pencil arm and parallel motion

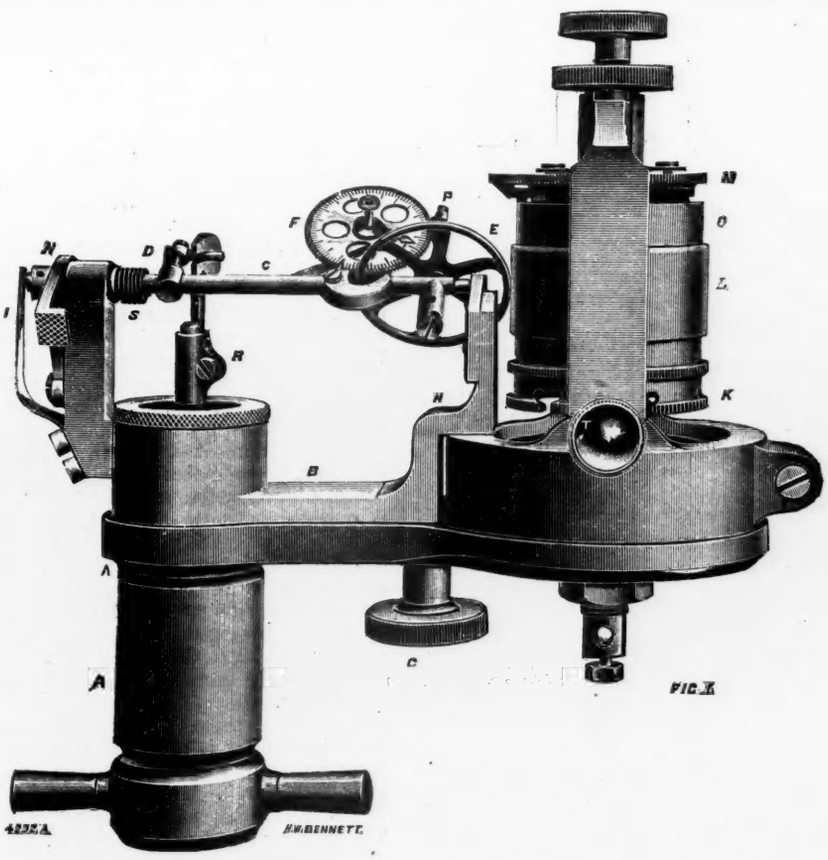


FIG. 1.

are replaced by a device similar to the integrating mechanism of a planimeter, the wheel of which can be placed at will in contact with the drum in order to produce the desired rotary effect upon the wheel resulting from the combined action of steam pressure and piston speed, the requisite inclinations of the wheel being imparted to it by a simple sine motion of pin and slot as shown at D.

Since, therefore, the varying pressure of steam in the cylinder is made to produce the same amount of inclination of the wheel, as would be produced by tracing the actual diagram with the tracing point of a planimeter, it only remains to rotate the wheel by reciprocating the drum in contact with it, in order to produce the same result as if the drum (*i.e.*, indicator card), were held fixed and the diagram traced round with the point of the planimeter in the ordinary way. The amount of reciprocation of the drum (*i.e.*, length of diagram), is accurately measured to the second place of decimals by means of a simple device, M, actuated by the drum itself and which is quite easy of manipulation. It will be noted from the woodcut that the wheel stands normally at a certain deflection from the vertical, viz., about 35°, the object of which is to secure an accurate action between the contact surfaces and which is quite effectual, as will be seen from the subjoined trials of the instrument at the works of Messrs. Willans & Robinson, Rugby, on an engine of their usual type running at 350 revolutions per minute. It should be explained that although this permanent amount of deflection increases the amount of the record on the dial on the forward stroke by an amount proportional to the permanent initial inclination, the same amount of record due to the same cause is deducted by the return stroke, the difference being the actual amount of rotation of the wheel, which, owing to the mathematical conditions governing the instrument, is precisely proportional to the amount of steam pressure on the piston of the indicator during one revolution of the engine. There is, of course, no slip between the contact surfaces other than that due to the amount of inclination from the horizontal. The action of this indicator is, therefore, briefly that of a planimeter recording the areas of diagrams at every revolution of the engine, which a card indicator would produce having the same piston area, the same piston spring, and a ratio of pencil movement to that of piston of six to one, the amount of reciprocation of drum being, of course, arranged to be the same for each.

For the calculation of H.P. by means of this instrument, the average area record per minute reduced to unit length by dividing by the amount of drum stroke if more or less than one inch was employed, is multiplied by a single figure composed of engine constants, &c., the result being the average H.P. per minute developed during the time the instrument was running. And for M.E.P. the unit area record per minute is divided by the revolutions per minute, which, in this case only, require to be known.

In cases, therefore, where a study of the steam distribution in the cylinder is not the object in view, but the actual efficiency of the engine, a knowledge of the latter can be much more accurately ascertained with the continuous indicator than by taking diagrams, and much labour in measuring them up is obviated, as also the necessity for counting

revolutions. Moreover, where rapid changes of load are the rule, an accurate indication of H.P. is an impossibility with the ordinary indicator.

In electric light and traction installations it would seem that this form of power-meter should obtain for itself a wide sphere of application, as indications may be taken with it during a whole day or night, or at regular fixed intervals of working; no attention to it being required, unless it may be desired to take readings during the run, which is readily done even at high speeds, as shown in the table below:—

HIGH SPEED.

Test of Little's continuous indicator, made at the works of Messrs. Willans and Robinson, Ltd., Rugby, December 22nd, 1897, on a steady load, indications being taken simultaneously by a Crosby indicator. The two instruments were attached to the low-pressure cylinder of a large engine, running at 350 revolutions. The load was an electric one, and was kept constant by maintaining constant watts by means of an amperemeter and voltmeter in circuit.

CROSBY INDICATOR.

—	Diagram.	Planimeter.		Area.	Length.	Scale	M.E.P.	Revs.
	O'clock.	Start.	Stop.					
1	4-12	0	·91	·91	2·1	50	21·67	350
2	4-0	·91	1·83	·92	2·1	50	21·91	
3	3-47	1·83	2·77	·94	2·1	50	22·38	
						3	65·96	
							21·986	

Crosby M.E.P., 21·986.

CONTINUOUS INDICATOR.

Time. Minutes.	Cumulative reading.	Reading per five minutes.	Reading per minute.	Stroke of drum. Inches.	Scale.	M.
5	50·5	50·5	10·1	1·09	80	21·18
10	102·2	51·7	10·34	1·09	80	21·68
15	154·5	52·3	10·46	1·09	80	21·93
20	208·5	54·0	10·8	1·09	80	21·65
25	260·2	51·7	10·34	1·09	80	21·68
30	313·2	53·0	10·6	1·09	80	22·23
35	366·0	52·8	10·56	1·09	80	22·14
					7	153·49
						21·927

Little M.E.P., 21·927.
For WILLANS & ROBINSON, LTD.
(Signed) P. A. LOW.

LOW SPEED.

Test of Little's continuous indicator, made at Messrs. Vicars, Sons and Maxim's Works, Erith, February 25th, 1898, on a large simple condensing engine, driving the machinery in their shops. Indications taken from one end of one cylinder simultaneously with a Crosby indicator.

CROSBY INDICATOR.

No.	Diagrams.	Areas.	Length.	Scale.	M.E.P.
	O'clock.				
1	3-55	1·74	3·02	50	Average, 28·1215
2	4-0	1·87	3·00	50	
3	4-5	1·87	3·02	50	
4	4-10	1·70	3·02	50	
5	4-15	1·68	3·02	50	
6	4-20	1·56	3·01	50	
7	4-25	1·61	3·02	50	
8	4-30	1·81	3·02	50	
9	4-35	1·52	3·02	50	
10	4-40	1·62	3·04	50	
		10 | 16·98	10 | 30·19		
		1·698	3·019		

Crosby M.E.P., 28·1215.

CONTINUOUS INDICATOR.

45 minutes' run:—Total reading, 195·6; stroke of drum, 2·95 inches; 100 spring; reading per minute, 4·3466; revolutions, 52·1.

$$\frac{4{\cdot}3466 \times 100 \times 10}{2{\cdot}95'' \times 52{\cdot}1} = 28{\cdot}27.$$

Little M.E.P., 28·27.

ELECTRIC TRACTION PROJECTS FOR THE 1900 PARIS EXHIBITION.

AT the last Paris Exhibition it will be remembered that the little Decauville light railway in the Exhibition grounds, proved not only a great convenience to visitors, but what is of quite as much consequence, it was entirely a success from a financial standpoint.

No less than 6,000,000 passengers were carried on this little pleasure line, whilst the receipts amounted to a sum of £70,000. This success might naturally have been expected when we consider that the line was inexpensively built for a summer's traffic under very favourable circumstances—the expenses stopping as soon as the receipts grew less, and the line not continuing for the winter, when sparse traffic (or none at all) prevents profits being earned.

The people of Paris are evidently much inclined to favour light lines of this kind, as anyone will believe on seeing the little horse cars running through the top of the Bois de Boulogne into the Jardin d'Acclimatation; and we are rather surprised that no serious efforts have yet been made to run these cars by electricity.

However, there is no hesitation being shown with regard to electric traction schemes for the approaching exhibition, and if one is to judge from the successful Decauville line already referred to, there ought to be a most profitable season in 1900, were it only because the extent of ground to be covered is so much greater.

The schemes at present brought forward are five in number (according to information which we abstract from *L'Energie Electrique*).

The first is propounded by the French Thomson-Houston Company, whose design embodies a single track of metre gauge, with 22 motor cars and 33 trail cars. One class only is provided for, somewhat in contrast with the usual first and second classes to be found in Continental tramcars, &c. —and the fare is uniform, 2½d. This company asks for a subvention of £60,000, in return for which the Exhibition authorities are to receive all net profits on carrying up to 15,000,000 passengers, and two-thirds of subsequent profits for any further traffic. A cash guarantee of £4,000 is offered by the company that its system shall be worked successfully.

The second proposal emanates from a syndicate of which the chief member is the Decauville Company. This also is based on a metre gauge line, single track, taking current from a third rail. Ten motor cars and 40 trail cars would be provided, with a uniform fare and class as in the last case. The company asks for 55 per cent. of the gross receipts after £72,000 has been taken.

The third scheme is put forward by Mons. Leon Francq, acting in conjunction with the Fives-Lille Company. This proposal embraces a double track of normal gauge, with three-car trains having each a seating capacity of from 180 to 200 passengers. Twenty motor cars and 40 trail cars would be provided—all one class and one fare, 3d.—but special reserved seats at 5d. might be arranged for. Mons. Francq estimates the capital outlay upon his plans, if carried out, at about £140,000, and any receipts over and above such a sum would fall to the exhibition authorities. No payment, however, would be made except on the carrying of more than 15,000,000 passengers. From this number to 20,000,000 the concessionaire would pay one centime on each ticket, and similarly two centimes should the numbers range between 20,000,000 and 25,000,000; three centimes from 25,000,000 to 30,000,000; and five centimes or one half-penny per ticket for all over that number. Evidently Mons. Francq is ambitious and thinks that increased capacity for traffic will ensure the traffic coming into existence.

The fourth system is due to one of the Paris electric

lighting companies, which proposes a single track of metre gauge built generally on the Decauville principle, and employing 10 motor cars with 40 trailers. Two classes would be provided with corresponding fares of 5d. and 2½d. This concessionaire offers 20 per cent. of the gross receipts, and 25 per cent. of the net receipts after allowing for depreciation and 5 per cent. upon the expenses of erection and exploitation.

The last proposal—brought forward by Mons. de Mocomble—is supported by Mons. Henri Maréchal (the well-known Paris engineer) and the Compagnie Générale de Traction. It comprises practically two separate schemes, one an electric railway and the other a two-speed moving sidewalk somewhat after the fashion of those already suggested, or actually built, for Exhibition purposes, as at Chicago, &c. The railway is designed on the metre gauge, is single track, and provided with eight trains in service (three in reserve). Each train would have a seating capacity for 250 passengers, and would be operated by motors having an output of 140 H.P. A central rail would serve as current distributor.

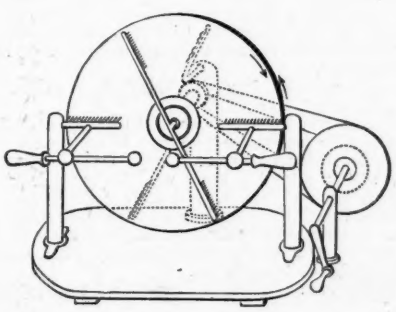
The "moving sidewalk" would run the opposite way round to the railway (it should, of course, be understood that all these proposals are for circular lines embracing practically the entire area of the Exhibition), and is built throughout on a viaduct after the fashion of the American elevated railways. It comprises a fixed platform approximately 3 feet wide, and two separate moving platforms, of which the first is about 2 feet 8 inches wide, running on a track of 18-inch gauge and maintaining a speed of about 3 miles per hour, whilst the second one has a width of about 5 feet 6 inches, with a track gauge of 3 feet, and runs at a speed of from 5½ to 6 miles an hour.

Our contemporary gives a very complete and interesting description of the working details of this moving sidewalk, and if the plans are adopted we shall hope to deal fully with the matter. At present it is sufficient to note that the power required to operate the combined arrangement is estimated to be about 472 H.P., and that nearly 40,000 passengers *per hour* can be dealt with.

HONOUR TO WHOM HONOUR IS DUE.

We read in a daily paper that Mr. James Wimshurst, inventor of the famous electrical influence machine, is one of the 15 men of science nominated by the Council of the Royal Society for election this year.

"The famous electrical influence machine" with which Mr. Wimshurst's name is associated was first described in *Engineering*, January 5th, 1883. On February 2nd in the same year a letter appeared in *Engineering* from Prof. Holtz, stating that the machine invented by Mr. Wimshurst had been invented by him (Holtz) in 1869. In one of the places cited by Holtz (*Pog. Ann.*, 136, p. 172), an influence machine is described, with an illustration, of which we subjoin a copy.



It will be seen from this figure that the machine consists of two glass discs driven by pulleys and belting in opposite directions. A neutralising rod with points for drawing off the electricity from the surface of the plate is set at a suitable angle opposite each disc. Collecting combs are placed in a horizontal diameter opposite the front disc.

Those who are acquainted with the Wimshurst machine will perceive that the only difference between it and the Holtz machine is in a few insignificant matters of detail. In the Wimshurst machine a number of radial strips of tinfoil are pasted on the surface of the discs. This makes the machine self-exciting. But Holtz pointed out in 1881 (Uppenborn's "Jour. of Prac. Elect." p. 199), that his machine could be made self-exciting by pasting tinfoil sectors on the face of the discs. He, however, considered that as the self-excitement could be obtained only at the price of loss of output, the tinfoil sectors were not to be recommended. Since Mr. Wimshurst's machine came before the public, more than one inventor has flattered himself that he has improved it by removing the tinfoil sectors. These ingenious inventors, unknowingly, no doubt, merely reverted to the original form of the machine as brought out by Holtz in 1869.

The second point of difference between the Wimshurst and the Holtz machine is in the collecting combs. In the Wimshurst machine the collecting combs are double, that is to say, there is one opposite the face of each disc. Now, Holtz states that he has tried the double collecting comb, and has found that it is not so good as the single comb.

Holtz may be wrong in both these matters of detail, but nobody could consider that it affects the principle of the invention one way or the other.

Mr. Wimshurst may have other claims to be elected a fellow of our leading scientific society, but it cannot be said that he has been elected because he is the first "inventor of the famous electrical influence machine." The scientific man often gets nothing for his discoveries except the honour of being the first discoverer, so there is all the more reason why the scientific public should see that honour is given where honour is due.

A NEW INTEGRATING MACHINE.

In another column will be found a description of Mr. W. G. Little's integrating steam engine indicator. This beautiful instrument is the latest addition to an interesting class of apparatus which has received much attention from mathematicians and mechanics in recent years. We suppose there are no problems of such entrancing interest as the construction of integrating machines to both the geometrician and the mechanic, while they exceed almost all other geometrical problems in immediate application to practical problems of surveying and engineering. The term integrator, in its widest sense, includes all the clocks which integrate time, the automatic coal weighing machines which integrate mass, the gas and water meters which integrate volume, the electrical motor meters which integrate the product of force and time, the chemical meters which integrate mass or volume according as they act by the weight of metal deposited or the volume of gas generated, as well as this indicator of Mr. Little's, which integrates the product of force and distance, *i.e.*, work. Integrators were in use when Alfred put candles in lanterns, and when Galileo and Huyghens applied the pendulum to clocks. Calculating machines, such as Babbage's and the Brunsviga, curve tracers, and tide predictors are not integrators, though they perform mathematical operations of an allied kind. The integrating machines which have occupied so much of the attention of mathematicians during the last 30 years, and perform such curiously complex operations, are all machines for calculating the properties of plane or developable curves, closed or periodic. The initial impulse was given to these designs by the invention of Prof. Amsler's well-known planimeter, largely used now for measuring areas on maps and engineer's drawings, and more commonly still on indicator cards. The use of a similar instrument for obtaining the volumes and moments of inertia of solid figures swept out by the rotation of closed curves about an axis is less generally known, but it suggests as possible an almost indefinite extension of the principle to other problems; the principle, *i.e.*, of counting the revolutions of a wheel rolled over a surface, the speed at which the wheel revolves depending on its movement over the surface, and the angle between its plane, and the direction of its motion. All the integrating machines that we know of, produced since that

time, depend either on this principle of Amsler's, or on moving the wheel along a revolving cone. The latter plan is less elegant, geometrically speaking, and less elastic in its applications, but it has been useful in some cases. We may recall its employment in Siemens's steel wire slack percentage indicator, and within the last few months has been described a singularly complicated and inelegant application of it to a recording and integrating electrical instrument by Richard Fréres, in which the cone has its extreme form of a disc. But of integrating machines working on the same principle of Amsler's in some form a great variety have been proposed. In South Kensington Museum there are several models of rolling wheel and cylinder integrators designed by Mr. Vernon Boys. A very ingenious planimeter using a Peaucellier cell is due to Prof. Hele Shaw. The ergometer, or integrating transmission dynamometer of the Rev. F. Jarvis-Smith is probably the most perfect instrument of its kind yet designed, and Prof. Henrici's harmonic analyser made by Conradi, of Zurich, is a real triumph of mechanical design and construction. The list could be increased almost indefinitely. All these instruments, depending on the perfect rolling together of two bodies, suffer more or less from slip, and the error is apt to increase with the speed of the operation, and with the angle between the directions of motion of the two bodies at the contact point. Prof. Unwin's first letter to Mr. Little mentions his apprehension that the error due to this cause in the readings of the indicator might prove serious, but it seems clear that good workmanship and design have reduced the error to a very small amount, and it is probable that the indications of Mr. Little's instrument are at least as trustworthy as the figures obtained from a series of cards. The design would not have appeared to us to promise great accuracy; we should have looked rather to an instrument on the lines of the ergometer; but Mr. Little's figures are unexceptionable, and he has, without doubt, produced an extremely valuable instrument. It is unnecessary to point out the convenience of using such an indicator in prolonged steam trials, though it is probable that cards would be taken at intervals in addition as a check. We have no doubt that the instrument will be found in all laboratories and engine-testing rooms, and that its use will suggest to engineers other useful applications of integrating apparatus.

CORRESPONDENCE.

Electrolytic Refining of Lead.

I have just read the article on the electrolytic refining of lead that Mr. Sherard Cowper-Coles has published in the ELECTRICAL REVIEW for April 22nd last.

As this article contains some criticisms relating to my process of electrolytic desilverisation of lead, I ask you to permit me to say a few words in answer thereto.

Firstly, in the numerous experiments that I have had occasion to make on different kinds of lead, I have never observed any deposit of peroxide of lead ($Pb\ O_2$), nor any other oxide on the anodes.

Secondly, the composition of the bath does not vary, for the acetic acid is not at all decomposed; and, in fact, during the passage of the current through the baths I have never detected the smallest escape of gas.

Here, then, are the well-established facts that everyone can test, and which are, however, in contradiction to the observations (which are, by the bye, very polite) that Mr. Sherard Cowper-Coles has addressed to me on the subject of my process of electrolytic desilverisation of argentiferous lead.

D. Tommasi.

Knots.

Some interesting correspondence on the subject of the *knot* has recently appeared in your journal. The term "knots per hour" has long been an abomination to many of us when used in the sense of "miles per hour." The excellently put protest against the use of "*knot*" for "nautical mile," which opened the correspondence alluded to, has been, I am confident, widely appreciated. I write to call your attention to analogies which ought to suffice to fix the meaning of *knot* to give it the meaning of "one nautical mile per hour." One analogy is the ampere, which expresses a rate of flow of electricity; another, is the watt, which expresses a rate of production or consumption of energy. Add to these the knot, expressing a rate of speed, the miner's inch, expressing a rate of flow of water, and a few others, horse-power, &c., and we have a group of practical units, whose analogy is interesting and instructive in, at least, one case, the ampere. Then just as a current of 10 amperes indicates a flow of 10 coulombs per second, so does a speed of 10 knots indicate a speed of 10 nautical miles per hour. But the ampere is not a coulomb, and the knot should never be treated as a nautical mile. A slight struggle against this misuse of the knot may be traced in our dictionaries—it is to be hoped that the misuse may vanish. But when we remember how many years were required to educate professional electricians out of the expression "one-hundred volt current," or "thousand volt current," we must not be too hopeful.

T. O'Conor Sloane.

New York, *May 7th.*

LEGAL.

COOPER *v.* THE ELECTRICAL INSTALLATION COMPANY AND ANOTHER.

Rights of a Patentee under an Assignment.

BEFORE the Court of Appeal, composed of Lords Justices A. L. Smith, Chitty, and Vaughan Williams, on Saturday, May 14th, the case of Cooper *v.* Electrical Installation Company, Limited, and another, came on for hearing. This was an appeal by the plaintiff from an order by Mr. Justice Darling in Chambers, in the Queen's Bench Division. Mr. E. W. Sinclair Cox was counsel for the appellant, and Mr. George Wallace for the respondents.

Mr. SINCLAIR COX said the defendants in the action consisted of two companies, the Electrical Installation Company, Limited, and the O'Brien-Lennard Electrical Installation Company, Limited, and the order appealed from was an order striking out plaintiff's statement of claim in so far as it affected the O'Brien Company, on the ground that as against the O'Brien Company it disclosed no reasonable cause of action. The plaintiff, Mr. Henry Hayes Cooper, was the inventor of an electrical safety wall plug, and the patent was originally in the names of Cooper and the Electrical Installation Company. By agreement of July 19th, 1894, plaintiff assigned to the Electrical Installation Company his moiety of the patent.

Mr. WALLACE: They were joint patentees in the first instance.

Mr. SINCLAIR COX said that Cooper and the Electrical Installation Company entered into covenants under the agreement, for themselves and their respective representatives and assigns, by which the company was to pay to assignor Cooper royalties half-yearly in respect to each article manufactured under the patent by them or their licensees, to pay all stamp duties and fees for keeping up the patent, and to do all in their power to promote the manufacture and sale of articles manufactured under the patent, and the use of the invention in every possible way, and not to manufacture or apply any other invention which might supersede or tend to supersede the patent assigned. The deed also set out that the Electrical Installation Company and their assigns, should keep proper books in respect to manufacture and sale under the patent, plaintiff to have access to them. By his statement of claim the plaintiff said that the defendant O'Brien Electrical Company, Limited, became successors and assigns of the Electrical Installation Company, Limited; he said the defendants were guilty of breaches of covenant by omitting to pay certain royalties and stamp duties, and to keep proper books and accounts, and he claimed to be entitled to proceed against the O'Brien Electrical Company on the ground that they were the successors and assigns of the Electrical Installation Company.

Lord Justice SMITH pointed out that there was no contract for the O'Brien Company to pay stamp duty.

Lord Justice CHITTY: Though I covenant that myself, and assigns will do something, my assigns are not bound by my covenant—unless it is something connected with land.

Mr. SINCLAIR COX said first there was this agreement with the Electrical Installation Company, then there was a license granted by the Electrical Installation Company to Messrs. Hodgson & Todd, then there was an assignment of the interest of the Electrical Installation Company to the O'Brien Electrical Company, who were not only their assigns but also their successors.

Lord Justice CHITTY: What do you mean by successors, as distinct from assigns?

Mr. SINCLAIR COX: In this way. They took over the whole of the undertaking of the Electrical Installation Company.

Lord Justice CHITTY: That is to say, they were assigns.

Lord Justice SMITH: All you can do is to produce a contract by the Electrical Installation Company that the other people will do certain things. That is not a contract with the other people.

Mr. SINCLAIR COX: I produce a contract between the plaintiff and the defendant Electrical Installation Company "and their respective assigns."

Lord Justice SMITH: How can that be?

Mr. SINCLAIR COX pointed out that this was not a document by plaintiff or his assigns to pay a certain sum of money. It was an agreement by which plaintiff handed over his whole interest in a patent, so as to prevent himself from in any way being concerned with the manufacture of anything under the patent, and he not only did that in respect to the Electrical Installation Company, but in respect to their assigns.

Lord Justice SMITH: Where is the contract between the O'Brien Company and you?

Mr. SINCLAIR COX argued that the O'Brien Company became the successors of the whole undertaking of the Electrical Installation Company, which had disappeared into them, and he submitted that he was entitled to go against them.

Lord Justice CHITTY: I was looking to see if there were any negative covenants, but there are none.

Mr. SINCLAIR COX submitted that there were both affirmative and negative covenants. If he might cite a case——

Lord Justice SMITH was curious to see a case in which, under these circumstances, the assignee was bound by the assignor's contract.

Mr. SINCLAIR COX cited the case of Werderman *v.* Société Générale, but that case and the one before the Court their Lordships declared to be as different as two poles.

Lord Justice SMITH: Have you any allegation in this statement of claim that the O'Brien Company took what they did take with notice of the contract?

Mr. SINCLAIR COX: I say there is no direct statement of notice——

Lord Justice SMITH: Then no direct notice is no notice at all.

Mr. SINCLAIR COX argued that all he had to do was to show reasonable cause of action, and he alleged in the statement of claim facts from which it could reasonably be inferred that the O'Brien Company had notice of these conditions. They were successors of the original company.

Lord Justice CHITTY: A phrase which I cannot for the life of me understand.

Lord Justice VAUGHAN WILLIAMS: Do you mean by successors that they were posterity?

Mr. SINCLAIR COX said they described themselves as successors of the Electrical Installation Company, and that, he submitted, showed that they had notice of the conditions under which the Electrical Installation Company did their business, the whole of the liabilities of which they took over.

Lord Justice SMITH: How can you come to a court of common law for breach of a contract between A and B which does not exist, and ask B to pay you damages?

Mr. SINCLAIR COX: Because B holds the patent.

Lord Justice CHITTY: If you are suing on the equitable ground of notice you ought to have stated it. Your explanation of them as successors, which I can hardly accept—it is very ingenious—you say involves notice?

Mr. SINCLAIR COX said if they were successors, they succeeded to all the rights and liabilities of the company which they effaced, and amongst those liabilities was that in respect to the assignment of this patent. This case was not limited to damages for breach of contract.

Lord Justice SMITH: The main part is for damages.

Mr. SINCLAIR COX said the plaintiff asked for royalties due, for an account, and for a declaration that he was entitled to access to the books. If the O'Brien Company was struck out of the case, it would defeat the whole power of the plaintiff to protect himself, because the Electrical Installation Company was gone, and his rights in respect to the patent, which was now in possession of the O'Brien Company, had disappeared.

Lord Justice SMITH delivered judgment, observing that the appeal must be dismissed. With any question of equity he had nothing to do; he took this statement of claim, and reading it according to its plain English, this was an action claiming damages against the two defendant companies for breach of contract. The O'Brien Company said to plaintiff, "Produce your contract that I have made with you." No such contract could be produced, because the O'Brien Company never did make a contract with the plaintiff, and the point taken was, that inasmuch as plaintiff was suing for damages he failed, because there was no contract between the O'Brien Company and himself. Plaintiff's contract was, that the Electrical Installation Company and its assigns would do certain things; and when a person entered into a contract of this nature "for himself and his assigns," his contract was that he or his assigns would do what he had contracted to do, and if his assigns did not do what he had contracted that they should do, then the cause of action was against the person contracting for himself or his assigns; it did not give cause of action against the assigns. It had been argued that plaintiff had title in equity on counsel's interpretation of "successors," as implying that the O'Brien Company had notice, and if plaintiff by amendment or alteration could make out another cause of action against the O'Brien Company, well and good; but at present he had not done so. In his judgment, the order that the O'Brien Company should be struck out of the claim should stand, plaintiff having leave to amend, this appeal being dismissed with costs.

Lord Justice CHITTY was of the same opinion. Neither in law nor equity could a man covenant for his assigns so as to bring them by his covenant into his contract; there must be an independent contract between them. It might be that plaintiff might make out a case in equity by proving that the O'Brien Company had notice, but there was no allegation of notice in this claim; and if he intended to set up equity against the O'Brien Company, it ought to have been done in a manner which was not done in this case.

Lord Justice VAUGHAN WILLIAMS concurred, holding it to be a fatal defect in this claim that there was no allegation that the O'Brien Company took the assignment with notice of the antecedent agreement.

Lord Justice SMITH observed that while this judgment held Mr. Justice Darling's order to be right and dismissed the appeal, if Mr. Justice Darling thought fit to grant plaintiff indulgence to amend he might do so.

Mr. WALLACE said no question of amendment was raised in Chambers.

Mr. SINCLAIR COX: I understand your Lordship to say I shall have leave to amend?

Lord Justice SMITH: Yes; apply within seven days.

COLMAN *v.* KEMPE.

ON Saturday in the Queen's Bench Division, before Mr. Justice DAY, sitting without a jury, the case was heard of Colman *v.* Kempe. This was an action brought by Mr. Alexander Colman against Mr. Harry Robert Kempe, to recover £98 4s. 2d., commission earned as advertisement agent in connection with the "Engineers' Year Book," of which publication the defendant was proprietor. The question turned upon the construction of a contract in writing made between the plaintiff and defendant in January, 1894, by which the plaintiff had been appointed sole advertisement agent of the defendant, the plaintiff contending that having been appointed sole agent he was entitled to receive commission on all advertisements sent to the "Engineers' Year Book," and the defendant contending that he was not entitled to receive commission on advertisements obtained by his employer without the plaintiff's intervention. It appeared in the course of the evidence that the plaintiff had issued a number of circulars for the purpose of obtaining advertisements, and it was upon the advertisements obtained through the medium of these circulars, amongst others, that he based his claim.

His LORDSHIP gave judgment for the defendant. He said that the plaintiff, having been appointed sole agent, would have been entitled to resist the appointment of another agent, but that although sole agent he was not entitled to commission upon orders for advertisements received by the defendant without the intervention of the plaintiff. Judgment accordingly.

Mr. Cagney and Mr. Ritter were counsel for the plaintiff, while Mr. Bray, Q.C., and Mr. Hume Williams represented the defendant.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

WEEK ENDING MAY 17TH, 1897.	£	s.
Alexandria	70	0
„ Teleph. mat.	23	0
Amsterdam	30	0
Bilbao	25	0
„ Teleg. mat. ...	21	0
Buenos Ayres	30	0
„ Teleg. wire	407	0
Calcutta...	133	0
Cape Town	583	0
Cologne	480	0
Colombo	18	0
Copenhagen. Teleg. wire	12	0
Delagoa Bay	86	0
Durban	246	0
East London	121	0
Gothenburg	386	0
Hamburg	54	0
Malta	96	0
Marseilles	73	0
Melbourne. Teleg. mat.	85	0
Montreal	25	0
Rio Janeiro. Teleg. mat.	133	0
Rosario	212	0
Sandakan. Teleg. mat.	19	0
Sarawak. Teleg. mat.	15	0
St. Petersburg. Teleg. cable	214	0
Singapore. Teleg. mat.	69	0
Stockholm	58	0
Sydney	719	0
Vera Cruz	21	0
Total ...	£4,464	0

WEEK ENDING MAY 17TH, 1898.	£	s.
Berbice	11	0
Beira. Teleg. mat. ...	373	0
Bilbao. Teleg. mat. ...	400	0
Bombay	78	0
Boulogne	110	0
Brisbane	40	0
Buenos Ayres	380	0
„ Teleg. mat.	65	0
Calcutta...	74	0
Cape Town	846	0
Copenhagen	15	0
Demerara	42	0
Durban	428	0
Flushing	36	0
Fremantle	39	0
Lisbon	2,310	0
Madras	9	0
Melbourne. Teleg. mat.	170	0
New York. Teleg. mat.	532	0
North Atlantic. Teleg. cable	11,520	0
Novorossisk	23	0
Penang. Teleg. mat. ...	356	0
Port Elizabeth... ...	250	0
Shanghai	393	0
Singapore	466	0
St. Petersburg	200	0
Sydney	44	0
Teneriffe	19	0
Townsville	14	0
Wellington	122	0
Yokohama	43	0
„ Teleg. mat.	99	0
Total ...	£19,516	0

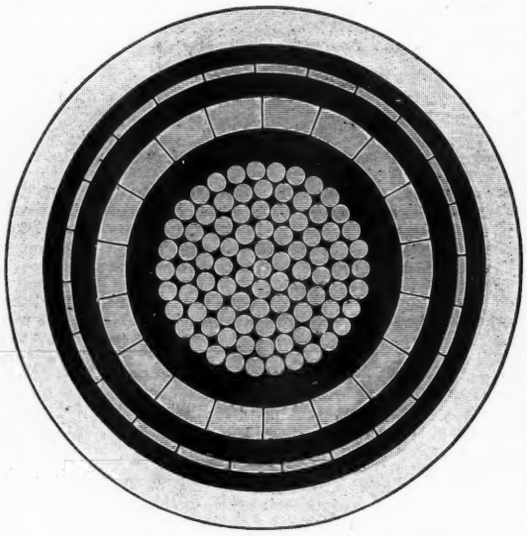
Foreign Goods Transhipped.

	£	s.
Syracuse	27	0

	£	s.
Syracuse	105	0

Auction Sale.—Messrs. Percy Huddleston & Co. are to sell by auction seven tramway cars and a quantity of electrical plant, including dynamos, motors, arc, and incandescent lamps, carbons, switches, numerous fittings, cables, &c. See our "Official Notices" for particulars.

B. I. Cables for Glasgow.—The illustration shows the full size section of the triple cable recently supplied for Glasgow by the British Insulated Wire Company. This cable has a sectional area on each of the inner conductors of 1 square inch, the neutral or outer conductor having an area of ·3 square inch. The net weight of



the cable, exclusive of drums, is 45 tons per mile, and it is believed that this is the largest cable that has yet been built. The whole of it was tested at a pressure of 2,500 volts for 15 minutes before leaving the factory, and we understand that a sample of the cable was, in Mr. Chamen's presence, bent six times in opposite directions round a 3 feet barrel, and the insulation afterwards withstood successfully a pressure of 30,000 volts alternating for 10 minutes.

Books Received.—"Elementary Chemistry: Practical and Theoretical." (First year.) By T. A. Cheetham, F.C.S. Published by Blackie & Son, 50, Old Bailey. Science Hand-books Series. 1s. 6d.

"The Electric Wiring and Fittings Details Book." By W. Perren Maycock, M.I.E.E. Published by Whittaker & Co., London. 2s. 6d. net.

"Electro-Dynamics. The Direct Current Motor." By C. A. Carus Wilson. Longmans, Green & Co., Paternoster Row. 7s. 6d.

Catalogues and Lists.—Messrs. Dobsons & Curtis Bros., Limited, of Dublin, have issued a second edition of their illustrated catalogue of electric lighting supplies. The list includes a variety of electric lighting switches, wall plugs, cut-outs, and other fittings of that character, also lamps, brackets, pendants, &c. The firm has recently opened an electrical fittings showroom in Stephen's Green, Dublin, where a large varied stock of electric lighting fittings and supplies is kept. The firm makes a speciality of switch and distributing board work.

A splendid volume of several hundred pages has been issued by Messrs. Ernest Scott & Mountain, Limited, in which are bound together sections 1, 2, 3, 4, 5 and 10 of their catalogue. The electrical trade is well acquainted with the class of work made at the Close Works, Newcastle-on-Tyne, which is mainly in heavy electrical engineering plant and machinery. The compilers have aimed at making the book a useful work of reference for civil, consulting, and electrical engineers, shipbuilding firms, and buyers of machinery generally, and we think they have achieved their object. Section 1 is a useful collection of general information on several important points. It gives a comparison of the relative costs of gas and electricity, and some instructions by Mr. Mountain for fixing and working dynamo-electric machines; the notes for dynamo attendants as to current required for various sized lamps, loss in cables, &c., are sure to be of use. Section 2 is mainly devoted to the "Tyne" dynamo machines and combined engines and dynamos. Sections 3 and 4 are the more interesting, dealing with the electric transmission of power, and steam, gas, oil, and other motive power plants. In the former section are some general remarks regarding the application of electric motors to various industrial purposes, general instructions are given for ordering dynamos for these classes of work, and rules given for finding the power required to drive a dynamo, the power obtained from motors, the loss in volts in a cable, and the loss in watts in a cable. Electric pumping machinery, winding and haulage plant, cranes, hoists, portable drilling machines, coal cutting, ventilating and other machinery and apparatus driven by means of electric power are among the many items of interest in this excellent catalogue. There are numerous illustrations, and among these we particularly notice a full page group of eight 60-H.P. electric motors of special vertical type, which have been constructed by Messrs. Scott and Mountain for Messrs. Smith's Dock Company, Limited, of North Shields. Estimates appear for electric welding plants of several sizes. Section 4 describes steam engines and boilers, gas engines, oil engines, turbines, &c. Section 5 is devoted to arc lamps and accessories, projectors, accumulators, wires, and cables. Engineering specialities and machinery in general come in for treatment in Section 10, various types of steam engines, electrical and steam fans, pumps, condensers, combined engines and dynamos, being described and illustrated, and detailed accounts are also given of various colliery electric plants which have been installed by the firm during the past few years. These brief notes will suffice to give an idea of the vast amount of interesting matter which the book contains, and its service to electrical engineers and the others for whom it has been prepared is a foregone conclusion.

Messrs. Miller & Woods, of Gray's Inn Road, have issued a circular on electric signalling through space, describing their transmitter, receiver, and Tesla transformer for this purpose.

Church Lighting.—The contract for the electric lighting of the Trinity Church House, Great Portland Street, W., was placed in the hands of Mr. Leo Sunderland, of the Brush Electrical Engineering Company. The building contains a large public hall, with extensive gymnasium, class rooms, reading rooms, and residences for the clergy, and is wired for about 280 lamps. Mr. Sunderland has lately completed the lighting of St. Paul's Church, Clerkenwell; St. Paul's Church, Camden Square; the Church of the Smithfield Martyrs; St. Stephen's Church Room, East Putney.

The Edison and Swan United Electric Light Company have brought out a screw leaflet (No. 101) in which they show various screws, terminals, &c., manufactured at their Ponder's End works, where there has been put down special automatic stamping, piercing, and screwing plant. The list illustrates and gives prices per gross of binding screws and clamps and cable connections.

Electricity in Cork.—The contract for fitting the Cork Cold Storage Company's premises with electric motors, mentioned by us last week, has been given to the Cork branch of Messrs. Handley and Shanks, of Dublin. This factory, we understand, will be the first requiring over 100 effective horse-power to be driven entirely electrically in Ireland.

Fritsche's Motors.—Messrs. Wilhelm & Co., 11 and 12, Westmoreland Buildings, Aldersgate Street, E.C., have been appointed agents for the sale of Fritsche's electric motors for continuous current. They have issued a list of various types, starting at $\frac{1}{16}$ B.H.P., giving all necessary particulars and prices.

The Heilmann Company.—The Heilmann Company is about to be reconstituted and additional capital introduced.

Liquidation Notices.—A general meeting of the Thetford Electric Light and Power Company is to be held at the offices at Thetford on June 17th, at 12.30, to hear an account of the winding up from Mr. Lovewell Blake, liquidator.

A meeting of the Manchester Edison-Swan Company is to be held at the offices of Messrs. Needham, Parkinson, Slack & Needham, solicitors, 10, York Street, Manchester, on June 15th, at 12 o'clock, to hear an account of the winding up from the joint liquidators, Messrs. Gover & Sharples.

Creditors of the British Electrozone Corporation must send particulars of debts and claims to Mr. A. E. Edwards, liquidator, 8, Trafalgar Buildings, Northumberland Avenue, Charing Cross, W.C., by June 25th.

Machinery Users' Association.—We have received the report of this Association for the year ending March 31st, 1898, which was presented to the annual general meeting held at Westminster Palace Hotel on Wednesday. The report shows the work done during the year in the way of negotiation, legislation, and litigation for the furtherance of the objects of the Association.

Mavor & Coulson.—This firm have brought out a somewhat elaborate book of 60 pages, in which they describe at length, with the aid of some good illustrations, the various departments at their new works at Glasgow, which we have already illustrated in the ELECTRICAL REVIEW. The arrangement of the matter and blocks is neatly done, and a thick glazed paper is a great advantage to the production.

Three-Phase Plant.—The Bristol Waggon and Carriage Works Company, Limited, of Bristol, have placed in the hands of Messrs. Thos. Richardson & Sons, of Hartlepool, a contract for putting down a three-phase plant for electric lighting and machine driving at their works. The aggregate power of the motors will be 230 horse-power, and for lighting the works there will be used 20 arcs and about 759 glow lamps. The power is at present generated by five Lancashire boilers, with an equal number of engines. By the adoption of electricity the economy in steam will, it is claimed, be such as to enable the whole of the power, including the lighting, to be supplied by one Lancashire boiler, while the total saving effected, after allowing for all charges, will be considerably over £1,000 per annum. Notwithstanding this saving in steam power, it is anticipated that the present machinery, with the improved driving arrangements, will produce from 10 to 20 per cent. more work. The generators and motors will be supplied by Messrs. Richardson, of Hartlepool. The boiler will be fitted with a Bennis automatic stoker and Green's economiser, while a Bennis automatic damper regulator will be provided in the main flue. The engine will have horizontal compound side-by-side cylinders, and in order to provide spare power for extension it will be capable of developing a maximum of 400 indicated horse-power. This contract has been placed in the hands of Messrs. Geipel & Lange, London, who are Messrs. Richardson's agents.

Wireless Telegraphy.—The first installation of Marconi's wireless telegraph system in Ireland for business purposes was made at Clara, King's County, last week, at Messrs. Goodbody's factories, the transmitter being placed at their flour factory and the receiver at their jute works, a mile away. It is reported to have worked most successfully.

ELECTRIC LIGHTING NOTES.

Alderley Edge.—An early start is to be made with the construction of the electricity works at Belmont, and it is expected that current will be available before the end of the year. The plant to be put down will supply 5,000 8-C.P. lamps, and the three-wire continuous current system, with feeders, is to be adopted. The mains will first be laid along London Road and Macclesfield Road to Underwood Road, meeting others laid in Woodbrook Road, and continuing to Rookwood, Trafford Road, Hey's Lane, Wilmslow Road, and Brook Lane.

Amblecote.—The District Council having been requested to join the Kingswinford Council in getting a provisional order for the electric lighting of the district, has resolved not to withdraw its opposition to the application of the Kingswinford Rural District Council for lighting powers so far as Amblecote is concerned.

Bangor.—The City Council has resolved upon the extension of the electric lighting scheme to Upper Bangor, and to amend the application already made to the Local Government Board for sanction to borrow an additional £3,500 for this purpose.

Barnsley.—The Council adopted the electric lighting scheme proposed by Mr. Miller, on Tuesday last week. Mr. Miller's report recommended the three-wire direct current system, with 230 volts at consumers' terminals. This system, he mentions, would also be suitable for electric traction, if adopted. The plant proposed would supply current to 6,000 8-C.P. lamps, and will comprise three Lancashire boilers 7 feet 6 inches by 28 feet, working at a pressure of 160 lbs. per square inch, and one economiser having 192 pipes; three sets of 125 I.H.P. steam engines, each coupled to a shunt-wound dynamo of 75 kw. capacity. There will be two batteries of accumulators, each consisting of 125 cells, and having a capacity of 500 ampere-hours; and there will be two transformers to raise the pressure for charging from the station 'bus bars. Two balancing transformers will regulate the pressure on the two sides of the three-wire system. The site for station is situated at the Town's Yard. The total cost is estimated at £23,322. The capacity of the plant could be doubled by an outlay of another £2,000 on plant and £500 on buildings. For public lighting it is proposed to employ 10-ampere arc lamps for lighting the main streets, and incandescents for the smaller streets. There would be 35 arc lamps, complete with cables, &c., to cost £45 each, and 30 incandescents at £4 per lamp, the total cost being £1,695. The maintenance and interest and repayment total out at £2,820 per annum. The revenue is estimated at £3,000. 7d. per unit will be charged for the first hour, and 3d. after.

Belfast.—The Electric Committee recommends the adoption of the Wright charging system, 7d. to be charged for the first hour and a half, and 2d. afterwards; power will be 4d. and 1½d. per unit on the same conditions. The matter comes before the Council in June.

Birmingham.—It is stated that the General Purposes Committee and the Birmingham Electric Supply Company have arranged terms for the purchase of the company's plant and business by the Corporation. The conditions have yet to be submitted to the Council and to the company's shareholders. The matter has been in the hands of a Committee for the past 12 months. The Birmingham *Mail* says that the terms of purchase are on the basis of £10 10s. per £5 share, which is about their actual Stock Exchange quotation, and but little, if at all, in excess of the market value of a gilt-edged and improving 5 per cent. security. On these terms, if they are accepted, there can be no question that the Corporation would secure a bargain for the ratepayers, seeing that the company's dividend is an advancing one, and that the needful money can be raised for considerably less than 3 per cent. For 1891, the first year of the company's existence, the net profit earned was only £361. For 1892 a dividend of 3½ per cent. was paid. For each of the three following years the distribution was at the rate of 4 per cent. For 1896 it was raised to 4½ per cent., and last year's dividend was at the rate of 5 per cent., with a balance of £1,042 carried forward. The capital expended on works to the end of last year was £215,050, in addition to £4,027 spent in obtaining Parliamentary provisional orders, and the total assets were valued at £244,504. At the annual meeting, in March last, the directors were authorised to raise the capital of the company to £300,000, by the creation of 20,000 additional ordinary shares of £5 each, but it was understood that nothing would be done in the matter until the issue of the negotiations with the Corporation was known.

In regard to the above statement, the Lord Mayor at Monday's meeting of the General Purposes Committee made it clear that *no* provisional agreement had been entered into with the company. It is understood that Mr. Harris (of Bramwell & Harris) has not yet officially submitted the results of his investigations as to the position of the company. It is expected, however, that the matter will be ripe by the middle of next week, and may come before the City Council at the June meeting.

Bournemouth.—The Town Council have under consideration the appointment of an electrical inspector, but are deferring it until their installation for lighting the pier and gardens is laid. Messrs. Cash & Co., who tendered for this work, having notified that their tender would be increased, and the Electric Light Company declining to do the work as the Council proposed to generate their own supply, the Town Council on Wednesday (May 18th) decided to advertise for fresh tenders.

Bradford.—It has been resolved to light the Bolton Road tramway route from Foster Square to Peel Park Gates, and the Horton route from the bottom of Morley Street to Laisteridge Lane, by electricity—a total of 40 arc lamps being placed upon the poles to be erected for carrying the electric cable for working the tramways, the total estimated actual cost of this lighting being £500 per annum.

Bridlington.—On Saturday night last there was a trial of the new electric light installation on the New Spa, and the whole length of the promenade will in future be lighted by electricity.

Bromley.—Mr. W. A. Dickinson has written to the District Council on behalf of the ratepayers and inhabitants of Bromley, to strenuously protest against the proposed erection of electricity works, with chimney shaft 120 feet high, in the centre of the town.

Camberwell.—The General Purposes Committee reported at last week's Vestry meeting that the Board of Trade had conditionally approved the alternating current system of the County of London Electric Lighting Company, and to the use of an earth connection on the system of mains on the extra high pressure system.

Cardiff.—The Corporation is giving public notice that next month it will apply to the Board of Trade for permission to alter the standard pressure at which energy is supplied. No change will be made in the supply to premises which have used current since March 4th, 1896, without the consent of the consumer.

Clonakilty.—The Town Council is of opinion that there should be some improvement in the lighting of the town—oil lamps are now used—and electric lighting is favoured. The Council has been in communication with Messrs. Handley & Shanks, electrical engineers, of Cork, who put forward a scheme estimated to cost £2,750. The Council has appointed a committee to inquire into the subject.

Cork.—The governors of the Cork District Lunatic Asylum held a special meeting the other day to consider the question of lighting the Asylum by electricity. Reports on the subject had already been received from two experts, and a detailed scheme submitted by the Cork Electric Tramway and Lighting Company. The company went very closely into the present gas lighting system and compared it with the electric lighting proposals put forward by them, showing the advantages of the latter. After a very lengthy discussion the governors resolved that it would be unwise to enter on this matter at present. The total cost per annum to replace the present lighting, including all renewals, was put at £561 odd. To run three 30-inch fans, each with a 2-H.P. motor, the total yearly cost is estimated at £132.

Cromer.—At the last Council meeting the clerk submitted *précis* of Mr. Gibbon's letter of March 24th, with the draft agreements and scheme as to electric lighting. After discussion, the surveyor was directed to report as to the cost of necessary works for establishing an electric light installation in the town.

Derby.—The Derby School Board contemplate introducing the electric light in some of the public schools of the borough, and at the meeting of that body on Monday afternoon a discussion took place as to the advisability of adopting the new illuminant in place of gas, and tenders were received for wiring the Traffic Street Schools, these ranging from £474 downwards. It was pointed out that the matter was proposed as an experiment, and on the ground that there was no immediate hurry, as the summer was coming on, it was resolved that the question be postponed. The chairman expressed the opinion that the experiment should be tried upon the new Orchard Street Schools.

Douglas.—Prof. Fleming, who has been consulted by the Corporation, recently visited the island, obtaining information on which to base his electric lighting report.

Durham.—Although the City Council at its last meeting apparently shelved the question of introducing electric light into the city on account of the satisfactory reports given in respect of several trial incandescent gas burners, those interested in the matter are keeping the agitation alive. Alderman Jepson, M.D., one of the leading spirits of the Council, has ascertained from Messrs. Edmundsons, of London, that street lighting in the city, which now costs £3 per lamp per annum, can be done cheaper by electricity, and that the firm are willing to introduce into any agreement that might be drawn up between them and the Council, a purchase clause. Alderman Jepson is taking steps to arrange a public meeting for the purpose of hearing an address from an electrical expert, and he hopes, by making plain the advantages of electric light, both as regards efficiency and cost, to bring about its introduction into the city at no distant date.

Folkestone.—The Lighting Committee estimate that an additional £1,500 will be required this year to pay for the extra cost of lighting the streets by electric light.

Germany.—A new central station has just been completed and put in operation at Wiesbaden. The plant, which has a capacity of 11,000 incandescent lamps, has been established by Messrs. W. A. Lahmeyer & Co., Frankfort-on-the-Main.

Glasgow.—The collection of electricity rents to date amounts to £30,386, an increase of £5,661 over the corresponding period of last year.

Glasgow.—A Sub-committee of the Corporation Electricity Committee has been appointed to confer with the Partick authorities regarding the proposal that the city should exercise the burgh's powers under its provisional order, and supply the burghal area with electric light. Negotiations are still proceeding with reference to the Clyde Trust's request for a rate, and a large engineering company have asked for a rate for about 600 horse-power to drive a portion of their machinery.

Hammersmith.—The Vestry's installation has been supplying current for private lighting for just over nine months, and for public lighting about six months, and the chief engineer now reports that up to the present time an average price of only 4½d. per unit has been received from private consumers, being the lowest obtained by any London municipal authority whose accounts have been published. The charge to the lighting rate is only £22 10s. per lamp per annum, as against about £40 per lamp per annum obtained by other authorities.

Hanley.—The Town Council is reducing the charge for electric motive power to 2½d. per unit for four hours per day, and 1d. per hour afterwards. The engineer is to approach the authorities of Stoke and Burslem with a view to ascertaining if they are willing to take electric current from Hanley in lieu of erecting separate stations for themselves.

Hove.—The Hove Electric Lighting Company having announced their intention of laying certain new mains, a member of the Council at its last meeting endeavoured to raise the question of the purchase of the electricity works by the town. Would it not be better, he asked, to purchase now, than wait till these mains had been laid down, and the cost had consequently increased? He was ruled out of order as the matter was not on the agenda, but there is little doubt that Hove will, before long, purchase the electricity works for the town.

Hull.—At a meeting of the Electric Lighting Committee on 13th inst., the chairman (Mr. Skinner) in presenting the annual accounts said that they commenced the year with the carrying out of a large extension of the electric system to the west and the northward, estimated to cost £40,690, for which they had borrowing powers. These works were well in hand, the buildings were nearing completion, and the equipment was proceeding with due despatch, and in a very short time they hoped to be able to put to use this latest addition to the enterprise and energy of the Corporation. During the year they had had, with scarcely an exception, a continuance of the support so largely given to them before, supplemented by 134 new users, and 65 old customers who had increased their lighting, while many of the new customers required a very large supply. No accident or serious breakdown had occurred during the year. The total working costs were slightly in advance of last year, but this was more than accounted for by the increase in salaries and wages, by a heavy rateable charge, and by the necessity cast upon them of providing a supplementary plant to keep pace with the demands for current. The temporary works, erected in North Street for this purpose, had cost a sum of about £900, all of which had been charged to revenue account as repairs and maintenance. At the close of the financial year they reduced the charge for motive power. The total expenditure on capital account now amounted to £61,738, of which £14,153 had been spent during the year under consideration. The total received for the 12 months was £10,453, and the expenditure £5,450, leaving a balance of £5,003, out of which, after paying £1,496 interest on loans, and £1,457 contribution to sinking fund, the committee were left with a net profit of £2,040 for the year, to be carried to reserve. The increased demand being made for the current, even at this season, and the pledge made to the residents of East Hull, made it necessary that they should take in hand very shortly a further extension, and this was accentuated by the difficulty in obtaining electrical machinery quickly. The electrical engineer submitted an analysis of the works' costs during the 12 months ended March 31st, together with a comparison for the three previous years, as under:—

	Units sold.	Works' costs.	Rents, rates, &c.	Management expenses.	Total per unit.
		d.	d.	d.	d.
1894-5 ...	163,857	2·09	0·21	0·56	2·86
1895-6 ...	246,277	1·95	0·14	0·61	2·70
1896-7 ...	340,439	1·62	0·15	0·54	2·31
1897-8 ...	467,352	1·63	0·38	0·57	2·57

The committee regarded the reports as very satisfactory. The electrical engineer submitted a report, in which he recommended a further extension of the generating plant for the purposes of extending the electric light to East Hull. The engineer reported that on March 31st last the lamps actually connected to the mains were equivalent to 43,534 8-C.P.; applications to be connected with present mains, 17,666 lamps; and on the east side of the river Hull applications for 2,520—in all 53,720 lamps, against which the present capacity of supply is 36,666 lamps. Application to the Local Government Board had been made for sanction to borrow £10,000 for the extension to East Hull, but the sanction had been temporarily withheld till full details of the scheme should be submitted. The engineer urged that the time had now arrived to pursue the matter, and to consider the question of laying down additional mains, and he recommended a scheme modified from that of 1896. With regard to the sub-station, instead of placing it on the Holderness Road, as he formerly proposed to do, he recommended that it be placed as near as possible to the North Bridge on the west side of the river, so that the cables crossing the river should carry low tension current only, the cables to be laid side by side with the tramway feeder cables. The engineer's report also fully dealt with the details, and concluded by stating that the sum of £10,000 applied for would not be sufficient to cover the cost of the extensions now recommended, and that £26,000 would be needed. The report was received and adopted, and a resolution carried to apply to the Local Government Board for borrowing powers to the extent suggested.

Hyde.—The Council has appointed Messrs. Lacey, Clirehugh & Sillar as consulting electrical engineers.

Ipswich.—Last Friday the Board of Guardians had a long discussion regarding the scheme for electrically lighting the new workhouse. Tenders were sent in by Messrs. Laing, Wharton and Down, who quoted £3,583; Edmundson's Electricity Corporation, £3,208; and Crompton & Co., who quoted £3,035, less £220, if boilers made by Messrs. Taylor & Sons are supplied. The Committee had recommended that Messrs. Crompton's tender with Taylor's boilers be accepted. After discussion the matter was referred back, several speakers considering the outlay too heavy for them.

Keswick.—The *London Gazette* contains notice of the intention of the Urban District Council to transfer their 1896 electric lighting order to the Keswick Electric Lighting Company, Limited, for a period of 42 years. The company pays £520 for the order.

King's Norton.—The District Council's provisional order was passed by the Chairman of Committees in the Commons last week.

Lambeth.—The Vestry has approved of the plans of the generating station buildings to be erected by the South London Electric Supply Corporation.

Marylebone.—The Marylebone Vestry have agreed to let the Metropolitan Electric Supply Company lay a cast-iron conduit from their station in South Street, Manchester Square, to their station in Rathbone Place, according to a route prepared by the Vestry's surveyor, which is a diversion of that proposed by the company's engineer.

Matlock Bath.—The District Council decided last week to oppose the General Power Distributing Company's Bill.

Morecambe.—At the monthly meeting of the Morecambe District Council on May 9th, the manner in which the contract for the installation of electric light has been carried out was again referred to. Mr. Parkinson read a report of his recent visit to Colchester to test the first two sets of engines. He submitted the engines to a four hours' run and found one set satisfactory, so far as speed efficiency went. The other one he found required 440 revolutions per minute instead of 400 in order to obtain the full output. There were a number of details which he refused to pass, and gave orders for them to be remedied. He was of the opinion that the sets were smaller than those which had been ordered. He would recommend the Council to take the lesser dynamos from Mr. Parker with an abatement on each set, say, of £200. Mr. Parkinson said he would not like to promise definitely for Whit week, but if they got the two sets of engines last week they would be able to light 50 lamps for that time. In committee it was afterwards resolved that Mr. Parkinson, electrical engineer, test the steam dynamos up to the specified speed, and that he report the result to Messrs. Parker, Limited, and the Electric Light Committee. The tender of Messrs. J. Ash & Son, of Birmingham, for the construction of a tank at the electric light works was accepted. It was resolved that Mr. Parkinson write to Mr. Parker urging him to come over at once to meet the Council to discuss the question of the flue, as the matter was assuming a very serious aspect.

Newport.—At a recent meeting of the Electricity Committee, the consulting engineer, Mr. Robert Hammond, submitted a lengthy report upon the question of extending the low tension mains and the construction of sub-stations in Commercial Road. At the present time this district is served as follows:—(*a*) From Hill Street to Cardiff Road by the low tension network of small capacity, fed by three isolated underground transformers, this being the usual pioneer system. (*b*) From Cardiff Road to Constable's Lane direct from the high tension mains, the high tension being converted into low tension on the premises of the consumer. Mr. Hammond says that the policy that is generally adopted in connection with the system in use at Newport, is wherever the load shows signs of density, to replace isolated transformers with larger size transformers fixed in sub-stations and feeding on to a low tension network stretching about a quarter of a mile in each direction. Under this system the amount of electricity lost in conversion from high tension to low tension is minimised, as the larger the transformers the more efficient they are. As the demand is likely to be considerable in this part of this district, it is absolutely necessary that the distribution system should be put upon such a basis as to cope with a large number of lights, and the sooner this is done the more economically and efficiently that district will be served. The distance being one mile it would be impossible, without an immense expenditure in copper, to deal with it by low tension from one sub-station, and it is therefore necessary to feed from two sub-stations. Sites have been found for these in Cardiff Road and Albion Street. Mains capable of dealing with a load many times that now obtaining have been included, and it is also proposed at the same time to lay two new feeders from the generating station to the new sub-stations. Mr. Hammond recommended that the order for the cables be given to Messrs. W. T. Glover & Co. The recently sanctioned mains extensions include high tension service mains in Alexandra Road, which would be connected up to, and fed by, the existing high tension feeders above mentioned. These will continue to do good service in the more distant district. Mr. Ham-

mond has considered the possibility of drawing the new feeders into the 3-inch pipes already carrying one high tension feeder and one a main each; but fears such a course would lead to the almost certain destruction of the present mains, and has therefore allowed for the new mains to be laid quite independently, and on the solid system. Estimated cost of proposed extension of sub-station system and low tension distribution in Commercial Road:—Cardiff Road sub-station:—Distributors with trenching, £1,300; brick boxes, £50; altering services, £50; feeder (with trenching beyond L.T. main), £280; sub-station equipped, £800; extra feeder panel at sub-station, £40 = £2,520. Albion Street sub-station:—Distributors with trenching, £965; brick boxes, £25; altering services, £100; feeder (without any trenching), £360; station equipped, £675; extra feeder panel at station, £40 = £2,165; plans, engineering fees, contingencies, &c., £315 = £5,000. It was resolved that the report be received and adopted, and that the work which, with contingencies, is estimated to cost £5,000, be carried out as extras to the contracts of Messrs. Glover & Co. and the Electric Construction Company. In due course the committee's report came before the monthly Council meeting this week, and it was adopted. Although the electric light was only installed in 1895, it has already been found necessary to spend £30,000 in extensions, and the £5,000 authorised above will be an addition to the £30,000.

Paddington.—The Board of Guardians has referred it to the visiting committee to consider and report as to the advisability of providing the necessary electric lighting plant, &c., for the electric lighting of the workhouse and infirmary.

Pemberton.—The District Council has appointed an Electric Lighting Committee to inquire into the subject.

Peterborough.—The Town Council last Friday had a discussion *re* the appointment of an engineer in connection with the electric light undertaking. There was a proposal that Mr. J. C. Gill, C.E., who seems to hold the positions of water-works engineer and superintendent of the fire brigade, be paid an extra £50 per annum to look after the electric lighting undertaking until a profit is earned. This, however, was not passed, a counter-proposition to the effect that £100 per annum be the salary, being carried by 10 votes to five. The Council some time ago retained Dr. Fleming as consultant, and he is to continue in that capacity.

Pietermaritzburg.—Customers are applying for current in earnest now; already there are over 1,100 lamps connected to the old plant, and over 1,700 lamps ready for connection to the new plant, which is expected to be started in June. Messrs. Mowat & Still are very busy, having over 800 lamps of 8 C.P. already erected. They are also erecting 100 temporary lights and complete steam plant for the forthcoming Agricultural Show in May Week, and they have erected two very handsome arc lamp columns outside the Legislative Assembly, one on either side of Her Majesty's Statue, with the requisite underground piping and mains, and connected the Legislative Assembly with the Corporation transformer sub-station by means of a lengthy concentric armoured cable of large size. Other contractors are equally busy, and prospects for the industry look bright. The borough electrical engineer has adopted a very good and fair set of wiring rules, which ensures good work being done, and the best of materials being used, a strong contrast to other towns in South Africa, especially Johannesburg.

Poplar.—The Electric Light Committee's action in advertising for a resident electrical engineer to devise and supervise an electric lighting scheme, was approved by the Board of Works last week.

Portsmouth.—The Electric Lighting Committee proposes to borrow £5,000 for laying mains in additional thoroughfares. A committee is considering the desirability of electrically lighting St. Jude's Church, Southsea.

Mr. H. G. Burr has been appointed clerk of works for the extension of the electricity station. A building adjoining the station has been purchased for £325.

Provisional Orders.—The Bill to confirm provisional orders made by the Board of Trade relating to the burghs of Hamilton, Airdrie, Brechin, and Rothesay passed the Committee on Unopposed Bills on Wednesday last week.

On Monday the Bill to confirm the Bermondsey and Marylebone Provisional Orders was read a first time in the Commons.

A Bill has been introduced to confirm provisional orders made by the Board of Trade under the Electric Lighting Acts relating to Chelmsford, Melton Mowbray, Norwich (Extension), Preston (Extensions), and Warrington.

Radcliffe.—Mr. F. F. Bennett, consulting engineer, of Manchester, has been instructed to advise the Radcliffe Urban District Council on electric lighting, and to attend the Local Government inquiry.

Railway Train Lighting.—The question of train lighting recently occupied the attention of the South Indian Railway Company, and the matter was referred to the company's consulting engineer in London, Sir George Bruce, who advises the equipment of mail trains running between Madras and Tuticorin as a tentative measure, the equipment of the whole service to be decided by the result of the experiment.

Reigate.—Last week the Town Council held a special meeting to consider the minutes of the Electric Lighting Committee. Prof. S. P. Thompson was, on March 28th, engaged to advise the Council on the electric lighting question, and on April 25th the report was submitted, in which the Professor referred to the report prepared by Mr. Medhurst in November, 1895, and after considering the requirements of Reigate and Redhill at considerable length, he expresses the opinion that Mr. Medhurst's scheme was a well-advised one. On May 4th it was resolved to instruct Mr. Medhurst to prepare plans and specifications for the installation on the lines of his previous report, with certain modifications recommended by Prof. Thompson, and to ask him to state his terms. It was further decided to ask Prof. Thompson whether the sites of the Reigate and Redhill gas works, which the Council is thinking of purchasing, would be of any use as sites for electricity works. At last week's Council meeting Mr. Medhurst's terms were considered and accepted.

Ryde.—In officially announcing that the Board of Trade have refused an application to form an electric light and power company in this town, the Mayor, at a meeting of the Council last week, said that on consideration of what had transpired at the public inquiry it was his intention to call a public meeting to consider the matter, and decide what steps should be taken.

Salford.—On Wednesday the Salford County Borough Council considered a resolution of the Electric Light Committee, adopting the plans of Mr. John Holt, for the erection of a new generating station on land in Strawberry Road, at an estimated cost of £28,161.

Shoreditch.—At the Vestry meeting on Tuesday it was resolved, at the suggestion of the London County Council, to amend the application for a loan of £15,700 for electric lighting purposes to £16,537, so as to bring the expenditure up to March 25th, 1898. Mr. A. J. Hazell submitted the report of the Valuation List Committee with regard to the rating of the electricity works and the refuse destructor. The committee had considered a report from Mr. Mansfield Robinson (the Vestry Clerk) on the subject, and had resolved to calculate the rateable value at a 3 per cent. basis on the cost of the land and buildings, in accordance with the decision of the House of Lords in the case of the London County Council *v.* Erith. The Vestry approved this, and resolved to apportion half of the rateable value to the electric light undertaking, and half to the refuse destructor. Mr. H. E. Kershaw, who submitted the report and accounts of the Electric Lighting Committee, stated that the Vestry was to be heartily congratulated on the magnificent success during the past nine months in the sale of electricity. With regard to the wiring department there had been a loss of £158; but that branch had answered its purpose of counteracting some of the unsatisfactory practices pursued by some contractors. The results obtained were phenomenal in the history of any electric light undertaking for a period of nine months, since the gross profits amounted to £4,264, which sum, in the case of a company, would be equivalent to a dividend of 6½ per cent. After providing for redemption of capital and payment of interest, there remained a net profit of £2,072, which left a surplus of £700, after paying off the contribution from the rate. In conclusion, Mr. Kershaw mentioned that the committee had resolved to wait for 12 months before entering into the question of the cost of refuse destruction, since it would be unfair to consider the cost on anything less than a year's basis. Mr. Winkler complained of the accounts of the dust destructor not being included in those presented to the meeting, the speaker contending that the two sections of the undertaking should not be separated from each other. Nothing had been provided in the accounts for depreciation and for other items, and in his opinion the working of the refuse destructor was being carried on at a loss. Where would the surplus be at the end of the year? It would be cheaper to use coal for steam-raising purposes and to shut down the refuse destructor. He therefore moved, and it was seconded, that the accounts should be referred back in order that Mr. Adams (the accountant) might prepare a balance-sheet of the income and expenditure of the refuse destructor and electric lighting works jointly. The chairman (Mr. Wakeling) pointed out the impossibility, from a legal standpoint, of a joint report being prepared, and at his suggestion the amendment was altered in favour of a balance-sheet for the refuse destructor only being got out. Other speakers having followed, Mr. Kershaw replied to the criticisms at some length. On the amendment being put to the meeting, no votes were recorded, and eventually the report and accounts were passed.

Southampton.—The Council has resolved, upon the recommendation of the electrical engineer, that when the total number of units consumed by one consumer in any one year for lighting exceeds 30,000, the maximum charge be 5d. per unit instead of 6d. The electrical engineer recently reported that the number of units metered at the works during April was 17,468, an increase of 6,780, or 63 per cent. over the output for April, 1897; and that on April 21st the supply to the electric cranes had to be shut off for a few minutes owing to a slight accident to one of the temporary engines. During Mr. Manville's absence abroad Mr. Aldridge will look after the laying of the mains. Alderman Bone said at last week's Council meeting that the making good of the damage done by the recent accident at the works would be much less than was at first thought. With regard to the proposed alterations in charges, the Committee thought it was their duty to encourage large consumers, and they hoped that they would get one or two very large customers in consequence of the reduction.

Stafford.—The annual report of the Gas and Electricity Committee shows that during the financial year ended March 31st there was an increased amount of business in both spheres of its operations. In the electricity department the increase in the sale of current was very marked. There were now the equivalent of 6,200 8-C.P. lamps connected, as against 5,003 last year, and the current sold was 55,542 B.T.U., an increase of no less than 27 per cent., but the low tariff of charges fixed last May seriously affected the revenue. The sale of current amounted to £1,202 13s. 6d., as against £1,162 1s. 10d. last year, being an increase of £40 11s. 8d., or only 3½ per cent. The

total receipts were £1,292 12s. 9d. The total expenses amounted to £765 10s. 3d., leaving a gross profit of £527 2s. 6d. Adding to this £897 16s. 3d., brought forward, the total sum standing to the credit of the electric department was £1,424 18s. 9d. Out of that sum the Committee has paid £555 19s. 5d. for interest, £436 9s. 6d. in repayment of loan, and carried forward £432 9s. 10d. The total amount borrowed was £20,000, and the sum repaid is £1,271 13s., the debt on capital account now being £18,728 7s. The electric mains are now practically at the limit of their capacity, and if the demand for the electric light continues to increase, it will be absolutely necessary to incur considerable further expense on capital account in order to increase their capacity by doubling the pressure. The boilers, engines, and dynamos are ample for a considerably greater demand, and the whole installation is in the highest state of efficiency. The chairman of the committee, Alderman W. H. Peach, is about to retire. The Corporation at the same meeting voted Mr. J. F. Bell, the manager of the works, a bonus of £250, in consideration of the extra work he has undertaken in connection with the electricity department, and also on account of great increase in gas output.

Taunton.—Mr. E B. Thornhill, the borough electrician, reports that the Free Wiring Company is making very satisfactory progress, as during the past quarter it has installed the equivalent of over 500 8-candle-power lamps. There had been connected with the mains during the quarter the equivalent of 1,541 8-candle-power lamps.

The total new connections during the month of April have been equivalent to 512 8-C.P. lamps.

Train Lighting.—The London and South Western Railway Company are fitting up some of their new triple composite coaches with electric light.

Wakefield.—Mr. Wigham, chairman of the Electric Lighting Committee, last week reported that Messrs. Fowler & Co. had delivered the two engines for the electricity works. One was working to the entire satisfaction of the Committee, and the other was being fixed. Some connections were yet to make, but that was only a matter of two or three days' work.

West Ham.—Tenders were received for electric light fittings for public buildings in the borough, as follows:—Salmony & Co., 2½ per cent. below; General Electric Company, 5 per cent. below; National Free Wiring Company, 45 per cent. below; Electrical and General Engineering Company, schedule price; Beaver & Co., 11 per cent. below; William McGeoch, schedule price; Benham & Froud, 6 per cent. above schedule; Rogers & Co., 7½ per cent. below schedule; Verity, 5 per cent. below schedule. The tenders were referred to the Highways Committee.

The Guardians have decided to light the workhouse by electricity.

Westgate.—On Friday last a Board of Trade inquiry was held by Major Cardew in the matter of the application by the Isle of Thanet Rural District Council for a provisional electric lighting order within Westgate-on-Sea. The scheme was opposed on behalf of a number of objecting ratepayers. There was a numerous gathering of ratepayers present. Mr. Bartley Denniss, who opened the case for the promoters, urged that the price of gas, namely, 4s. 9d. per 1,000, which was the maximum charge allowed by the Westgate and Birchington Gas Company's Act, was hard on the consumers. It was agreed that the more modern method of lighting, as suggested by Mr. Hawtayne, would be not only an advertisement for the place, but a profitable source of income, which would go towards the yearly diminution of the rates, the consulting engineer's figures on this point showing an annual profit of from £120 to £130 a year. It was stated that although the town was small, the rateable value was exceedingly high. The success of the scheme was practically ensured. The estimated cost was under £10,000. The majority of the objectors are interested in the gas company. Mr. Hawtayne's figures were criticised in cross-examination by Mr. Morton Smith, and Mr. F. E. Gripper, consulting electrical engineer and expert, was called to speak as to Mr. Hawtayne's estimate, and put it at £15,000 instead of £10,000. He also pointed out that the house installations would cost on an average £1 per light. He also condemned Mr. Hawtayne's estimate of the working expenses as being too low. Mr. Monkhouse (Messrs. Burstall & Monkhouse) supported this view, and other evidence having been given in opposition to the scheme, the inquiry was adjourned without any definite date being fixed.

Weston-Super-Mare.—The Board of Trade did not intend to proceed further with the local syndicate's application for a provisional order.

Whitechapel.—Notwithstanding repeated promises, the report of the Electric Light Committee is not yet forthcoming, and at the last week's District Board there were signs of growing impatience on account of the prolonged delay in dealing with the matter.

Willesden.—The Board of Trade has sanctioned the Council's provisional order.

Windsor.—The Windsor and Eton Electric Lighting Company have extended their mains down Park Street. The company has adopted the slot meter system.

Woodstock.—The Lighting Committee is negotiating with an electrical engineer as to an electric light installation for the borough.

Ulverston.—The Board of Trade has advised the District Council that as the Windermere and District Electric Lighting Company had not carried out their order of 1895, they are considering its revocation, but would like to hear the opinion of the Council. The Council thought that unless the stipulations in the order were carried out, it should be allowed to lapse.

Yarmouth.—Mr. W. H. Preece has reported to the Council upon the recent explosion at the electricity works. He was of opinion that the cause of the accident was an undue level of water in one of the old single drum boilers, and the main question was the remedy for preventing a similar accident in future. The addition of four high-level indicators would be of advantage as a safeguard against future mistakes in gauging the water level. He did not recommend the addition of separators on the ground of the extremely heavy expenditure that would be involved—£250—and any omission on the part of the engine driver to observe the level of water in the indicators would at once lead to a probable accident, and therefore introduce further danger. Mr. Preece, however, suggested an improved system of drainage, which he could conveniently include in the new extensions. Mr. Preece's report closed with the following paragraph: "It is well to bear in mind that whatever precautions are taken in arranging safety devices, such precautions are rendered useless if carelessness is shown by the workmen. It is impossible to design work which is entirely independent of this contingency."

The Electric Light Committee received replies from the Yarmouth and Gorleston Tramways Company in regard to points raised by the town clerk on their application to the Corporation in regard to the supply of electric light and power in Gorleston and Southtown. The company intimated that they would ask for an extension of 29 years beyond the time mentioned in the order, giving the scheme a total life of 35 years. The company could not pay more than the permit if they took electric power from the Corporation for the tramways. The company would undertake the supply of public and street lighting, erecting a generating station, &c. The average charge made would be 6½d. per unit. If the Corporation provided the cables and handled the supply to private consumers, the average charge would be 4½d. per unit as metered at the company's switchboard. The company offered to supply the current, to maintain and clean street arc lamps on the tops of the trolley posts, at a charge of £22 to £28 per annum. If the Corporation supplied the standards the cost would be £2 per annum less. Incandescent lamps would be supplied, fitted into the existing gas lanterns where arc lamps were not needed, at £4 per annum, where the mains were already laid. The Corporation would be asked to take over the electrical plant when exercising power to purchase the tramway equipment, under the Tramways Act, at a premium of 10 per cent. upon the cost of plant. The company was not prepared to offer any concession, monetary or otherwise, to the Corporation for surrendering its rights. On a consideration of these replies the Electric Light Committee recommended the Council to adhere to its agreement of May 8th, 1897, when an understanding was given to supply the Tramways Company with electric energy according to a graduated scale, commencing at 3½d. per unit, when the amount of energy does not exceed 250,000 units per annum. Mr. A. Peaton said that Gorleston had equal right with Yarmouth to the enjoyment of the electric light, but if there were obstacles in the way of the Corporation carrying the light across the water, the offer of a private company to do so should not be refused. He moved that a special committee be appointed to consider this matter.—Mr. Ruddock seconded.—At the suggestion of the Mayor, Mr. Peaton substituted for his amendment a reference back to the Electric Lighting Committee.—This amendment was then adopted.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

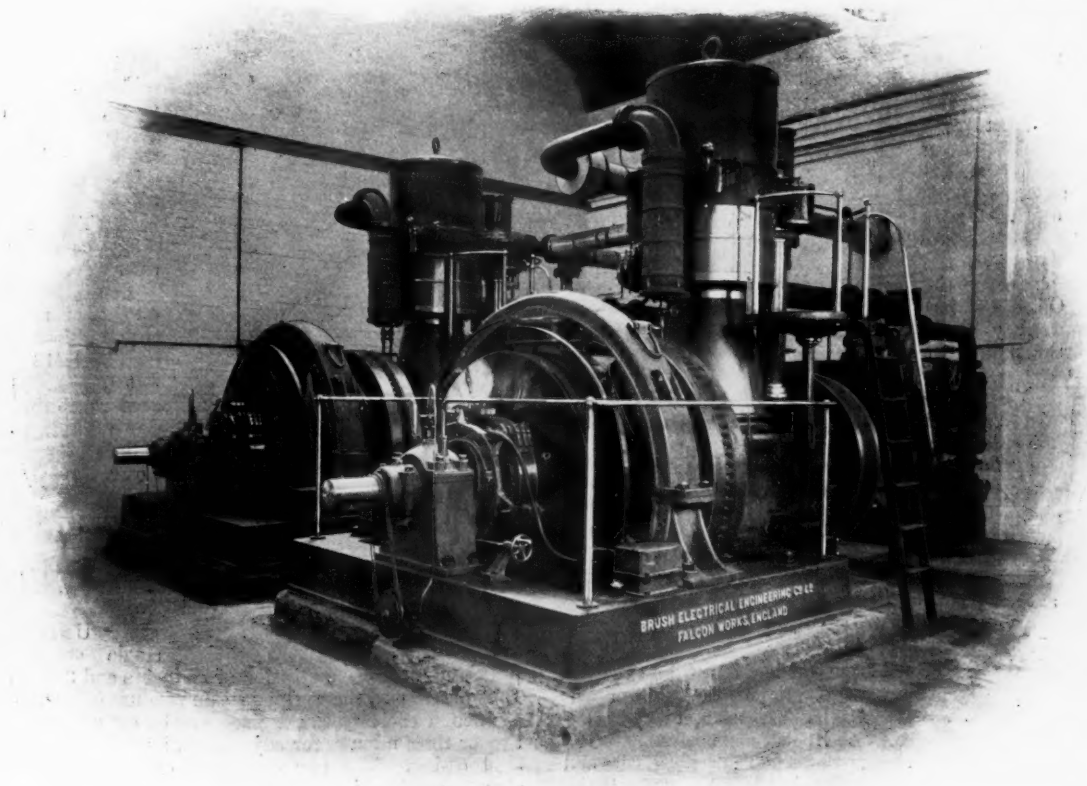
Barnsley.—Several communications respecting tramway proposals have been before the Streets, Buildings, and Improvements Committee, as follows:—(1) A letter dated the 30th ult. from the British Insulated Wire Company, Limited, asking for the consent of the Town Council to a proposed application by a company to be formed by the British Insulated Wire Company for a provisional order to enable them to construct and work tramways in the borough, and also offering certain terms in consideration of such consent; (2) a letter dated the 30th ult. from Messrs. Newman and Bond, explaining the proposals of the syndicate on whose behalf application has been made by them for the consent of the Council to an application for a provisional order; and (3) a letter dated the 3rd inst. from the clerk to the Worsbro' Urban District Council, suggesting that a conference take place between representatives of this Council and of the Worsbro' Urban District Council with respect to the provision of tramways in Barnsley and Worsbro.' These matters were to be considered by the committee at a special meeting arranged for yesterday, and each of the interested parties was invited to send a representative.

Bristol.—At the closing private meeting of the Sanitary Committee on the question of electric traction and tram extension in Bristol, all opposition on the part of the Corporation to the progress of the Tramway Company's Bills in Parliament was finally withdrawn. The opposition of private frontagers has also almost entirely disappeared. The final concessions of the company in the matter of fares are contained in a lengthy letter from the directors' solicitors to the town clerk.

(*Continued on page* 698.)

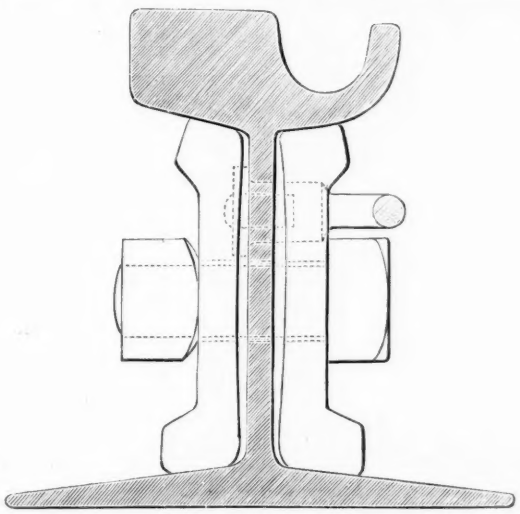
THE KIDDERMINSTER AND STOURPORT ELECTRIC TRAMWAY.

THERE is not much doubt that we are in a fair way to remove the reproach that has been so often cast at this country in the matter of electric tramways. The most pre-



VIEW OF GENERATING PLANT.

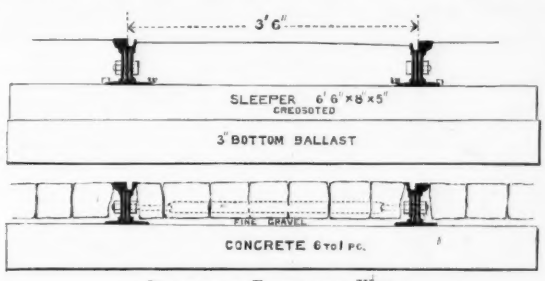
judiced patriot cannot deny that as a nation we have been slow to avail ourselves of the many great advantages offered by electric tramways. It is true that vested interests have



SECTION OF RAIL, HALF SIZE.

been in a large degree responsible for the lack of progress, but after all very little has been done to bring the merits of electrically operated tramways before the public, who are the real arbiters on social innovations. With a growing disposition on the part of municipalities, however, to control and operate electrical tramlines, we are in a fair way to bring the public in much nearer relationship with the benefits of mechanical traction. At the same time, without decrying in the least the laudable efforts of town authorities, there can be little doubt that much of the future of electric traction lies in the hands of private concerns, or perhaps we had better say that much of the immediate progress that will be made in this direction we shall owe to the capitalist.

It is obvious that a municipality is bound to be more cautious in adopting schemes that call for the outlay of con-

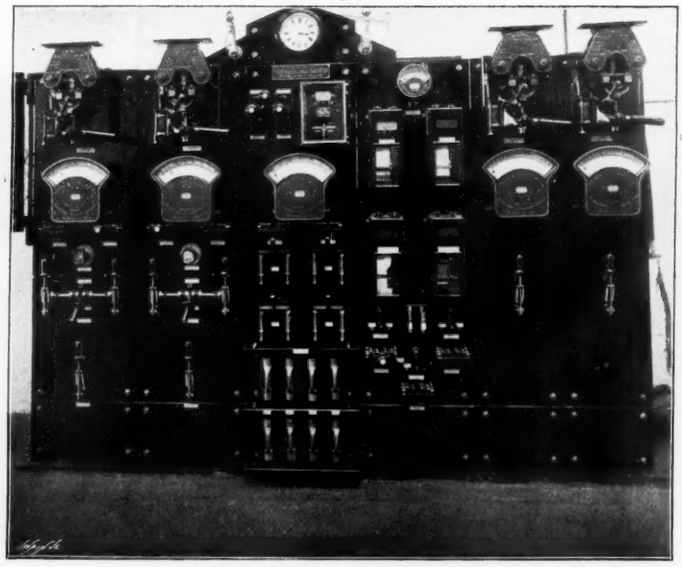


DETAILS OF PERMANENT WAY.

siderable sums of public money, consequently, municipal traction plant is of slow growth. It is quite true that the Corporations of Glasgow, Leeds, Sheffield, Dover, and Plymouth have recognised the merits of the system, but to show how much we must still rely on private enterprise, it is only necessary to say that one company alone—the British Electric Traction—probably one of the most powerful electric traction organisations in Europe, is contemplating

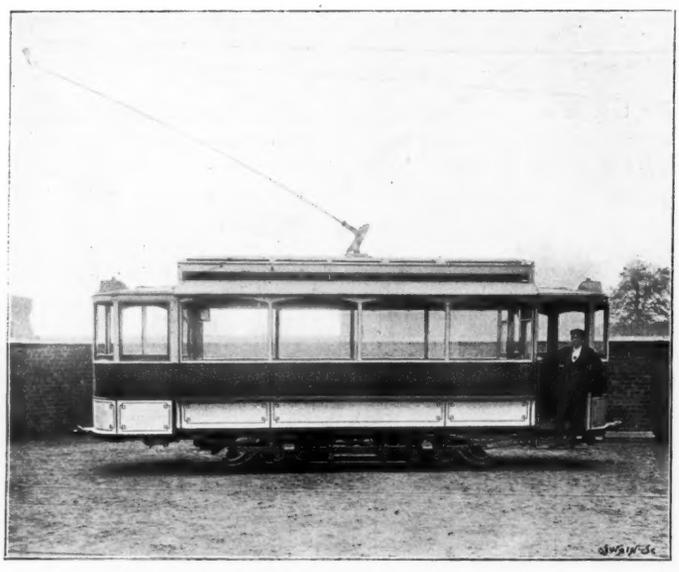
schemes which will involve an outlay of £3,000,000. The first completed system erected by this company is the one we are about to review.

The district of Kidderminster is an excellent place to demonstrate the merits of an electric tramway system. A portion of the route is a hilly one, and there is an unusual proportion of interesting scenery alongside the tramway. Hence one is able to show with what ease are gradients mounted and how little the posts and the overhead wires alter the aspect of a road. It will be seen from two of our illustrations that this is not an exaggerated statement; these views, moreover, serve another purpose—they show that the telegraph poles of the Post Office are immeasurably worse than the posts that support the trolley wire. Yet who ever heard the Postal Telegraph authorities accused of defloration of scenery? We have, however, reached a stage in the development of electric tramways when æsthetic considerations may be neglected.



Switchboard.

The Kidderminster and Stourport line is not an extensive one, but it is of special interest and importance at the present moment, because, since the American invasion, it may be considered the first line erected by British manufacturers. The steam plant, generators, cars, motors, posts, overhead wire and material all have been made in this country, and the Brush Electrical Engineering Company, the principal contractors, are to be congratulated, not only upon the successful completion of the line, but also because they have had the good sense to copy some of the best features of American practice. Prior to the introduction of the present electric system, there were no tramways in Kidderminster, the chief means of vehicular communication between different parts of the town and the outlying districts being a somewhat desultory service of omnibuses.



Car on Line.

Parliamentary powers for the line were obtained by the British Electric Traction (Pioneer) Company, Limited, under whose control the system has been carried out. Commencing at Somerleyton Avenue, about half a mile in an easterly direction from the Great Western Railway station at Kidderminster, the line passes through the chief streets of the sleepy old town; past the carpet manufactories that line the outskirts of the town, along the Stourport Road, where the country opens towards the valley of the Stour, thence it traverses the crossing of the Great Western Railway, terminating in Bridge Street, Stourport, on the banks of the River Severn.

The Generating Plant.

The power house possesses features of more than usual interest, arising from the use that is made of home-made plant.

The building comprises power house and car depôt which are arranged together upon an admirable site situated between the River Stour and the Worcestershire Canal, which is a little over a mile from the Kidderminster terminus, and 3½ miles from Stourport. There is shedding room for 10 cars.

The steam plant consists of two Babcock & Wilcox boilers, each of 1,218 square feet heating surface, and capable of evaporating 3,500 gallons of water per hour. A Green's economiser of 120 pipes is provided, the scrapers of which are driven by an electric motor.

The engines are of the "Universal" single crank compound type, and have cylinders of 20 inches and 30 inches × 12 inches stroke, the working steam pressure being 135 lbs.

Though enclosed the engines can be entirely exposed in two or three minutes for adjustment, by the removal of the steel casing. The two ends of the connecting rod are simultaneously adjusted by merely tightening the nut on the strut between the crosshead and crank pins, the operation taking quite a small fraction of time.

One of the principal features claimed for the Universal engine is that fluctuation of load does not produce water hammering, the engine being automatically self-draining. Steam is admitted only to the under side of the H.P. piston, the H.P. cylinder being drained throughout the whole of the downstroke by the valve, whilst the drainage of the L.P. cylinder is effected by the piston exposing a number of holes around the cylinder when at the bottom of its stroke. This quality is a most important one, particularly in traction work, where the variations of load are severe and priming necessarily more frequent than with steady loads.

There are two direct-coupled six-pole generators provided with Mordey's new chord winding and notched armature; they work at a pressure of 550 volts, and have a normal output of 100 kw., though they are capable of working to 135 kw. without a rise of temperature exceeding 80° F.

The most noteworthy feature about the machine is that the armature is of unusually large diameter in proportion to the width of field. This allows ample room for armature winding, notwithstanding the high voltage, and renders the whole of the windings and connections extremely accessible.

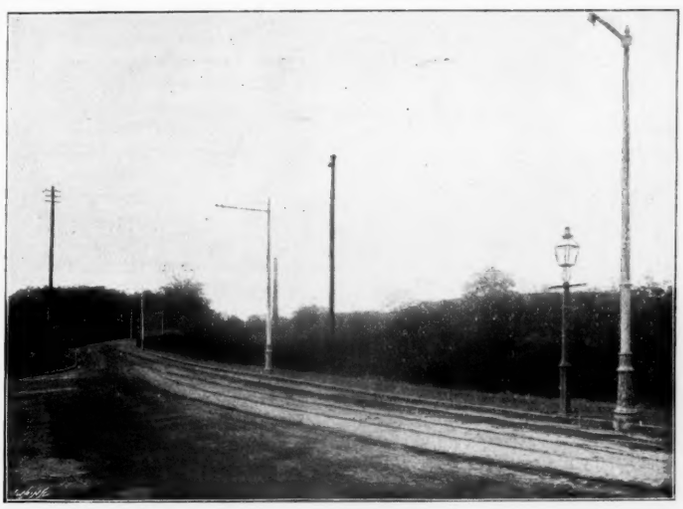
Owing to the adoption of the Mordey chord winding, the field coils are extremely small, as will be seen from the illustration, and no doubt the economy of copper in this respect is very marked. Each dynamo has a single bearing of ample proportions, provided with spherical seating, and is automatically lubricated by a small rotary pump.

There are two Wheeler surface condensers of the Admiralty type, one being provided for each steam set. The exhaust pipes are arranged so that either engine can exhaust to either one of the condensers, or if the condensers fail, means are provided for automatically exhausting direct to the atmosphere. An ample supply of water for the condensers is obtained from the canal, that for the boilers being obtained from the town mains.

The steam piping, which is arranged in duplicate, is of mild steel, the valves being manufactured by Messrs. Winn and Co., of Birmingham.

The arrangement of the switchboard does not differ materially from that usually adopted in American practice; it is split up into panels, which are known as the main station, generator, feeder, and Board of Trade panels. The main station panel is fitted with an ammeter, which shows the total output of the plant; and recording volt and watt-meters are placed on the same board. The generator panels are each fitted with an automatic circuit breaker of the General Electric type, an ammeter, shunt regulating switch, and plug board for station voltmeters.

The feeder panels are also provided with an automatic circuit breaker and lightning arrester. The inevitable Board of Trade panel contains all the instruments necessary to comply with the Board of Trade regulations.



The Line Along Stourbridge Road.
Postal Telegraphs v. Electric Tramways.

View of Line.

The Track Construction.

The line is single track throughout. The gauge is 3 feet 6 inches, and constructed throughout with girder rails weighing 75 lbs. to the yard. In the borough of Kidderminster the track is laid upon a bed of concrete 6 inches in thickness, and for 18 inches on either side of the track it is paved with 3 inches × 5 inches Clee Hill granite setts. Along the Stourport Road to the level crossing of the Great Western Railway the line, with the exception of one short length, is laid along the northerly side of the road, the rails being laid on sleepers, the space between the rails and on each side being made up with macadam. The return is entirely by the rails which are bonded with Chicago bonds.

This line is probably the first instance in this country of a tramway passing over the level crossing of a railway, and it is hardly necessary to say that a satisfactory means of doing this has necessitated much care. It was imperative that the tramlines should be broken where they intersected the railway, and to keep up the continuity of the return circuit of the tramway entailed carrying heavy copper connections from one side of the crossing to the other.

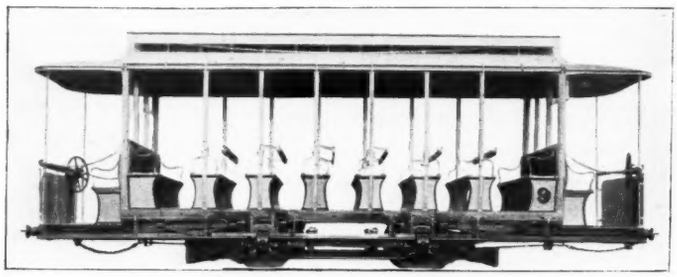
It generally follows that the introduction of an electric tramway system into a district brings certain road improvements in its train, nor has the Kidderminster line proved any exception to the rule, for the system has entailed very considerable road alterations along the route. The line runs mostly at one side of the road, and as a clear carriage-way had to be left for the ordinary traffic, it necessitated widening the roadway in many places, but, what was more serious, it involved the widening of three bridges. One of them being a double bridge spanning both the River Stour and the Worcestershire Canal, presented considerable difficulty, for the sides of the original bridge did not run straight, but in a double "S" bend, and to make matters worse, the arch spanning the canal was skewed. This bridge has been widened on both sides and made straight throughout its entire length of about 180 feet. The arch spanning the river was widened on both sides by building brick arches alongside, the new work being tied in to the old by means of tie-bolts carried right through from side to side. The skew arch could not be widened in the same manner, owing to the peculiar shape of the old bridge, and necessitated steel girder construction, the longest span being 38 feet 6 inches.

The Overhead Work.

Owing to various obstacles, it has been necessary in no less than three instances to place the poles on opposite sides of the road; that is, the poles and wires for some considerable distance are on one side of the road only, and then for

some distance on the other side of the road, when they again cross, so that the system provides excellent examples of the adaptability of the Dickinson side trolley with regard to the wire, for it must be remembered that the track cannot follow the variations that have been rendered necessary in the position of the overhead wire.

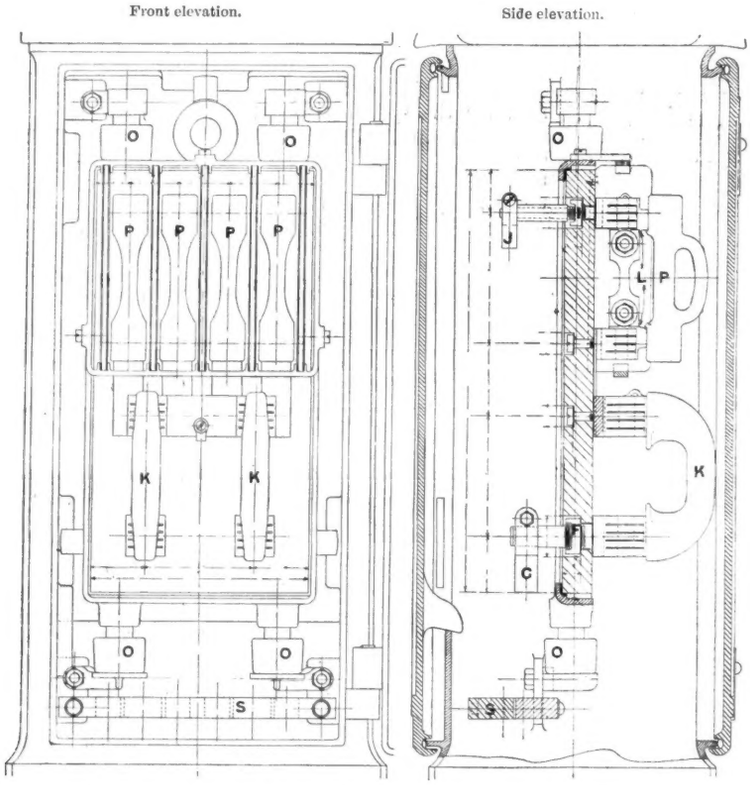
The overhead wire is suspended from tapered steel poles, 6 inches and 7 inches diameter, which are fixed at an average distance apart of 50 yards. They stand 22 feet above the ground, and are bedded in concrete to a depth of 6 inches below the surface of the road. Two trolley wires are provided, one for up line, and the other for down line working, the necessity for overhead switches at the passing places being thus avoided. The height from the rail to the trolley wires is 21 feet. The lengths of the bracket arms from which the trolley wire is suspended vary considerably, the longest being 8 feet 6 inches, and the shortest 2 feet 6 inches, the greater number being of the latter length. The trolley wire is suspended by riveted gun-metal ears, which are in turn suspended from bell insulators fixed to the bracket arms by wrought-iron clips.



Trailer.

wire. The feeder switches are shown at K in the detail drawing, and are capable of carrying 400 amperes, while the section switches are shown at P, and are designed to carry 50 amperes. Any section can thus be easily disconnected for testing, &c. The main cables are somewhat heavy on account of the considerable distance traversed. It has to be remembered that the power house is practically at one end of the system, which is, of course, dictated by convenience and economy. The east-going feeder is a 19/14 stranded cable, and extends to within half a mile of the Kidderminster end. The west-going feeder consists of a 37/11 cable as far as the third feeder box, from which point, and on as far as the next two boxes, it is reduced to 37/12, and from thence to the last feeder box it is reduced again to 19/14, finishing up within half a mile of the terminus. A 7/22 cable is connected to the rails at the extreme ends, and brought back to the switchboard for testing the drop in the return circuit.

The feeder cables, which are of the Diatrine type made by Messrs. Glover & Co., are lead sheathed and armoured; they are buried in the ground at a depth of 18 inches.



G and J, Clamp cable sockets; K, Main switch carrying 400 amperes; O, Oil insulators; P, Section switch; S, Clamp for cables.

Half-Mile Junction Pillar.

There are two main feeder cables from the power house, one going east towards Kidderminster, and the other west towards Stourport. As is customary on English lines, at every half mile the trolley wire is divided by section insulators, at which points the feeder boxes are located. These feeder boxes are about 4 feet 8 inches high, and are placed usually near the post supporting the sectional insulators; they contain two main knife switches feeding on to an omnibus bar, from which bar there are four cut-out fuses, which can feed both ways on to the double trolley

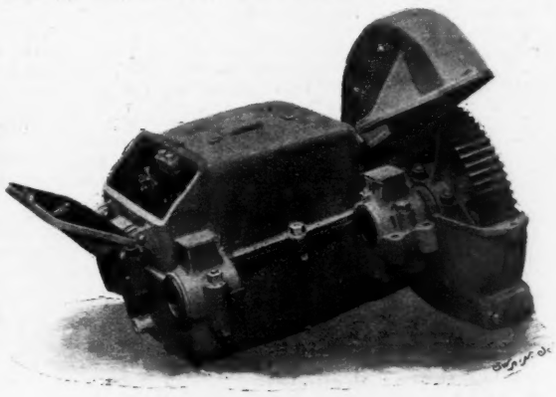
It will be noticed from the illustrations that the cars differ from the usual English practice, in that they are not provided with outside seats, and they are furnished at each end with vestibules. There are 10 in all, six of the closed type with motors 27 feet 6 inches in length over all and 6 feet 4 inches in breadth. These have a carrying capacity of 24 passengers; in addition there are three open trailer cars with a carrying capacity of 40 passengers.

The trucks are of the Brill cantilever type, with a wheel base of 6 feet 5 inches, the wheels being 2 feet 6 inches diameter. The bottom framing of the cars is constructed of teak, the body of teak and English ash, and the panels of Honduras mahogany. Each motor car is equipped with two 15-B.H.P. four-pole motors of the ironclad type, with spring suspension and geared to the axles with spur gearing having a ratio of 4 to 1. The armatures are of the drum type, slot wound with counterpart renewable coils. The armatures are cross connected, so as to have only two points of commutation, carbon brushes being employed.

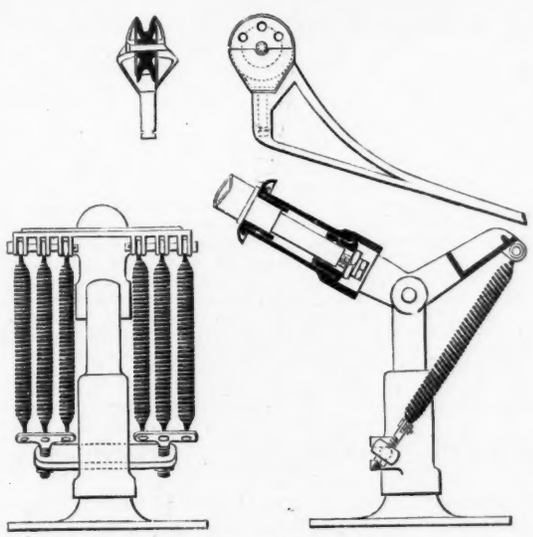
The controllers, one of which is fixed at each end of the car, are of the series parallel type, one controller handle being supplied with each pair of controllers, which are so arranged that it is impossible to detach it, excepting when the controller is in the "off" position. Each car is lighted with 10 16-C.P. incandescent lamps arranged in two circuits of five lamps in series. The interior of the car is lighted by three clusters of lamps, one containing four, and two containing two lamps, and a head light, which also lights the vestibule, arranged at each end over the platform.

The most interesting feature about the car is the trolley pole, which is of the well-known Dickinson type. It will be remembered that this device was first used on the South Staffordshire tramway, and the principle has been since pretty widely adopted on English lines. The chief difference that exists between the Kidderminster and the South Staffordshire trolleys is, that the horizontal springs used at the

base of the latter have been replaced by inclined springs. The detail drawings show the arrangements very clearly.



Car Motor and Gearing.

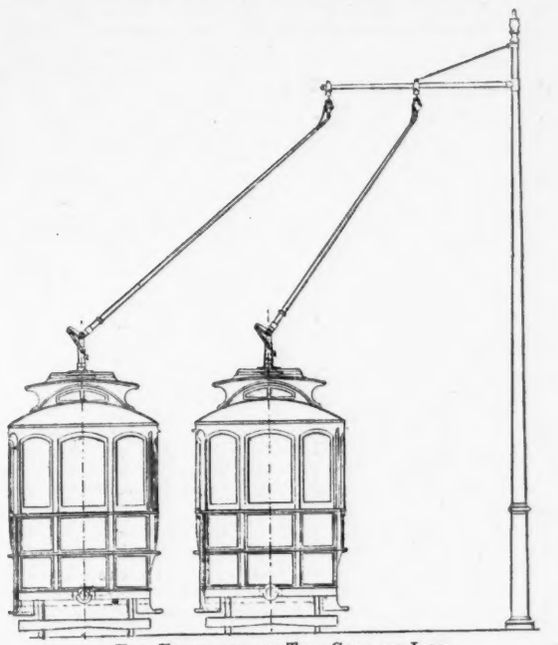


Details of Trolley Pole.

The trolley pole is a light steel tube 15 feet long, tapering from $2\frac{3}{8}$ inches to $\frac{3}{4}$ inch outside diameter, and fitted with swivel head, so as to allow the wheel to turn and adapt itself to any position of the trolley wire. The base of the trolley pole is supported on four insulators, as the whole of the pole forms part of the electrical circuit. Each car is provided with a lightning arrester.

As we have already mentioned, the contractors for the complete electrical installation were the Brush Electrical Engineering Company; the contractor for the permanent way and buildings was Mr. George Law, Kidderminster Messrs. James Russell & Sons, Limited, Crown Tube Works, Wednesbury, supplying the poles.

Messrs. Alfred Dickinson & Co., 120, Colmore Row, Birmingham, were the consulting engineers for the whole



End Elevation of Two Cars on Line.

undertaking, Mr. G. B. Parlett, A.M.I.C.E., being resident engineer and their representative throughout the work. On behalf of the Brush Company, the work has been carried out by Mr. Geo. Sillar, under the general direction of Mr. R. Dawbarn, superintendent engineer, assisted by Mr. S. Mahood, as resident engineer. We are much indebted to these gentlemen, as well as to the Brush Electrical Company for their assistance in compiling this article

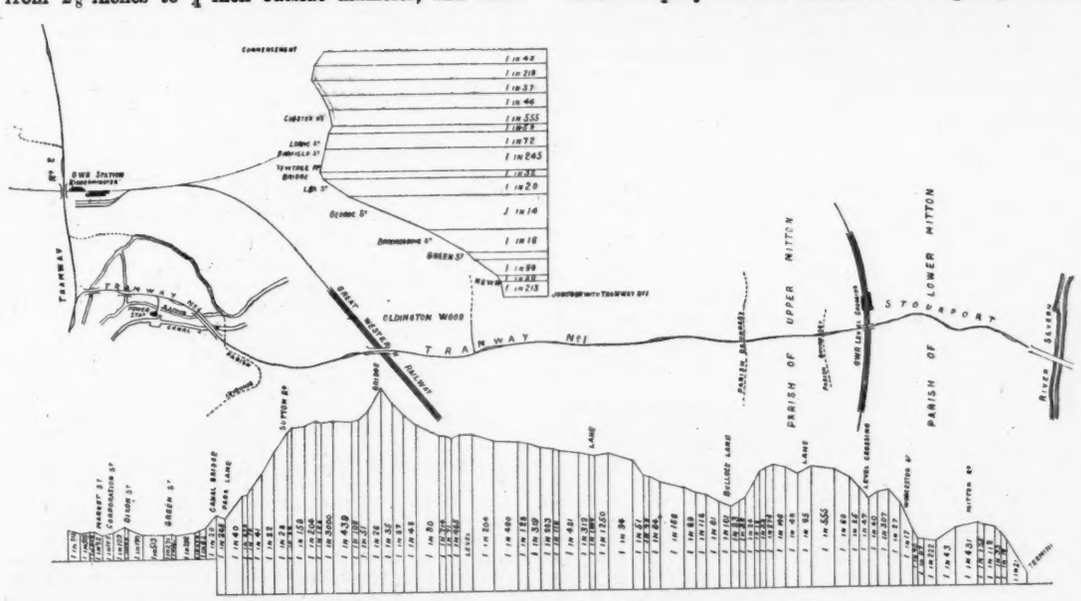


Diagram of Kidderminster and Stourbridge Tramway.

National Telephone Company.—It is stated that Mr. Faithfull Begg is named as the successor to Sir James Ferguson on the board of this company.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Concluded from page* 692.)

Bradford.—The Tramways Committee has now given up all hope of the possibility of the Bolton Road being ready for Whitsuntide.

Chesterfield.—The question of the adoption of electrical tramway traction is at the present time occupying the attention of the Corporation. There exists a tramline in the borough about a mile in length, but the extension of the system is under consideration, and as the hilly nature of the district renders horse traction both expensive and inadvisable the "city fathers" are considering the best substitute. The matter was ventilated at a meeting of the Council last week, when the matter of mechanical traction was mentioned. The following resolution was passed:—"That this Corporation recognise the advisability of applying mechanical traction on the present tramways, and that it be an instruction to the Tramways' Committee to have estimates prepared for the work and present to the Council at the next monthly meeting, bearing in mind any subsequent additions, and the necessity of providing workmen's tickets at nominal rates." A special meeting of the Council is to be called to consider the matter in all its bearings. Councillor Markham, in moving the resolution, referred to what is being done in electric traction in other parts of the country. He said that the Corporation had now the Brampton Tramway in their own hands, and it would be an easy matter to demonstrate on that piece of line whether electrical traction would be for the good of the town or not. He himself believed it would add very much to the prosperity of the town and add materially to the value of the land adjacent to the tramways if such a system were adopted. Alderman Wood, in seconding, said that they wanted to consider whether a small scheme to begin with, or enlarging the present tramway, would be a wise thing for the Corporation to entertain. To go into the question of supplying electricity for a tramline only a mile long would be going to enormous cost with very little benefit, and it would be much easier for the committee to report on a tramway double or treble that length.

City and Brixton Railway.—The City and Brixton Railway Bill, which has already been sanctioned by the House of Commons, has been referred to the Unopposed Bill Committee of the House of Lords, owing to the withdrawal of the threatened opposition. By this Bill, which will now in due course receive the Royal assent, a new company will be incorporated with a share and loan capital of £1,600,000 for the purpose of constructing an electric railway from Brixton Hill to a junction with the City and South London Railway at a point under the High Street, Borough. The period sought for the construction of the line is five years from the passing of the Act.

The Electric Power Schemes.—The Nottingham Chamber of Commerce on Monday resolved to support the Bill of the General Power Distributing Company now before Parliament.

Halifax.—The Tramways Committee made a trial trip on one of the electric cars on Tuesday. It is expected that the cars will commence running on June 9th.

Leeds.—The Highways Committee, on 11th inst., confirmed the recommendations of the management committee to extend the electric tramway system along Dewsbury Road and on the Headingley and Chapeltown routes. The city engineer (Mr. Hewson) reported that the city accountant's estimate respecting the cost of the electric tramways on the Kirkstall-Roundhay section had proved accurate, notwithstanding certain statements which had been made to the contrary. Mr. Derry's estimate per car mile was as follows:—For repairs, 5⅔d.; renewals, 1$\frac{7}{10}$d.; interest and sinking fund, 2½d.; total, 9d. The actual expenditure had been 8$\frac{7}{10}$d. per car mile.

Llandudno.—Mr. Preece has been consulted by the Electric Lighting Committee upon what system of traction they should insist upon with the Light Railway Syndicate. In his report Mr. Preece strongly advises the overhead system.

The Metropolitan District Railway and Electric Traction.—The shareholders of the Metropolitan District Railway Company had before them on Tuesday the Bills which are being promoted by their company. One of these is applying for further powers to the Metropolitan and Metropolitan District Railway for the ventilation of the railway, and in relation to the working of their undertakings by electrical power. Mr. Staats Forbes, in explaining matters, said that the Bill would give them power when the convenient time came, and the method was sufficiently developed, to apply certain funds of the company for the purpose of working by electricity the railways of the Inner Circle. The Metropolitan Company is applying for similar power, and the District Company could not dissociate itself from that company in respect to electrical communication. They were bound to work in harmony. One of the clauses in the Bill empowered the Metropolitan and District Companies to enter into agreements as to working of traffic by and supply of electrical power. Of course, the adoption of electricity was a matter they could not go into with absolute indifference as to the question of cost. A good deal, however, was now known about this form of traction. It had its advantages and its disadvantages; but the proprietors decided as far back as February last year that it was a matter they ought to be prepared to face at the right moment. Their idea was that £500,000 would be extremely well spent in adapting their railway to electrical traction over that particular part of it which he had mentioned, which was crowded with traffic, and so much of which was incapable of anything but very imperfect ventilation. They were instructed by very eminent authorities that the financial burden cast on the two companies would be extremely moderate in comparison with the great advantages to be secured not only by getting rid of many of the offensive qualities of the air in the tunnels, but also in the saving in the cost of traction, which they were advised would be considerable. The matter was one demanding some care, and they, naturally, wished to be in the hands of perfectly responsible engineers of eminence. In Sir J. Wolfe Barry, a man of considerable experience, who had advised the company almost from its inception, and Mr. Preece, the electrician of the Post Office, and one of the most distinguished members of his profession, they had thought well to vest the preliminary inquiries. Those gentlemen were now concerned in the matter, and the directors would not proceed until they were assured by the report and recommendations of those gentlemen that it was safe to do so. They were gradually gaining experience in the matter of electrical traction. The greatest enterprise of the kind yet approaching to anything like development was the Central London Railway. They knew a little about the question from what had been done on the City and South London line and the Liverpool Overhead Railway, but the Central London Railway, which would be running by the end of this year or the beginning of next year, would doubtless open their eyes to a good many things. The experience of that company would be very useful to the District and Metropolitan Companies. The Chairman then moved the approval of the Bill in so far as it affected the company.

Newcastle.—The lease of the Newcastle Tramways to a private company is rapidly running out, but the new committee of the Corporation is now moving in the direction of a complete scheme, and on Monday agreed to appoint as specialists, to prepare a full report, Dr. Hopkinson, to advise as to the electric system; and Mr. Colamb, C.E., of Edinburgh, to do the same in respect to cable tramways.

Nottingham.—It is stated that a special meeting of the whole Council in committee was held on Monday for the purpose of considering in detail the report of the Tramways Committee, which was presented to the Council on April 4th last, and was discussed a second time on May 2nd. After an exhaustive debate the report, slightly altered, was adopted. There were two dissentients; one objected to the position of the proposed tram centre in the Great Market Place, and the other was opposed to the overhead electric system; he preferred the cable system. The Council instructed the Tramways Committee to include in the Bill to be presented to Parliament several sites for the power stations in connection with the tramway system, in addition to the site originally agreed upon. At the same meeting the Council considered the Bill now being presented in Parliament by the General Power Distributing Company. The meeting authorised the Electrical Energy Committee to reduce the charges for the supply of electrical energy in the city, and also to extend the electrical undertaking all over Nottingham, both for lighting purposes and for power.

Penarth.—The Penarth Light Railway inquiry will probably take place at Cardiff on June 2nd. The opponents include the Cardiff Corporation and the Taff and Barry Railways.

Richmond.—"A Resident of Richmond" writes to the *Times* railing at the promoters of the proposed light railway over Richmond Hill, and flinging the invective at the overhead trolley system in the same old-fashioned way adopted in bygone days in the country. He says it is unfortunate that the promoters have not to apply to Parliament for powers. "All that is necessary for the London United Tramways' Company, Limited (the promoters of the scheme), being to obtain an order from the triumvirate composing the Light Railway Commission, and the approval of the Board of Trade." He adds, "It need hardly be pointed out how a lofty line of gibbet-like supports for the wire which conveys the electricity will interfere with the natural beauty of the neighbourhood, and it is sad to think of the sylvan glades of Petersham Common—perhaps unequalled in wild picturesqueness within so short a distance of London—being desecrated by the vulgar if useful tramcar and its iron way."

Southport.—The Town Council has an electric tramway scheme in view, for it has resolved to widen the esplanade from the promenade to the Birkdale boundary, and form a shrubbery as a preliminary to a future electric tramway round the Marine Drive.

Sunderland.—At the Town Council meeting last week Mr. Crown moved the rescinding of a minute recommended by the Tramways Committee, and passed at the last meeting by the Council, appointing a deputation of six members and the electrical engineer to visit a number of towns for the purpose of gaining information with respect to electrical traction as applied to tramways, for the benefit of the Corporation who are considering a scheme for the application of electric traction to, and for the aquisition of, the tramways of the borough. Mr. Crown said he had learned that the deputation had drawn up a programme to visit the Continent as well as towns in England. They were going to start at Newcastle, and go from there to Hamburg, from Hamburg to Berlin, from Berlin to Brussels, and Brussels to Paris, and from Paris to London and the English large towns. He thought there was no need for seven gentlemen to go any such distance and spend any such amount of the ratepayers' money, and he hoped that the majority of the Council would come to that conclusion. Of course, the gentlemen could go to St. Petersburg and New York, and Philadelphia if they liked, but what he did object to was to them going at the ratepayers' expense. There were ample opportunities at Hamburg to see all that was desired, and this was a cheap place to go to. There were also West

Hartlepool, Leeds, and Sheffield, towns all well supplied with electric traction, and he therefore moved that the minute be rescinded. Alderman Fairless seconded, and said he did not object to the deputation, but he thought the number was excessive. After discussion, Mr. Crown replied, and said the arguments for the deputation were fallacious. There was no amendment, and the motion was then put, and carried by 26 votes to 20.

Swansea.—The British Electric Traction Company, who have taken over the Swansea Tramway system have appointed Mr. Daniel Sugrue, late manager of the Swansea system, to be their district superintendent for South Wales, and have appointed him to a seat on the board. It is anticipated that the work of re-laying the lines will commence in a week or so.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1898 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Cayenne-Pinheiro ...	March 24th, 1898 ...	May 14th, 1898
St. Lucia-St. Vincent ...	May 16th, 1898 ...	May 18th, 1898
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Cable beyond Gurupa ...	April 4th, 1898 ...	
Cyprus-Latakia	Feb. 10th, 1898 ...	...
Bolama-Bissao	April 12th, 1898 ...	...
Maranham-Para	„ 17th, 1898 ...	...
Kotonou-San Thomé ...	„ 27th, 1898 ...	...
Hong Kong-Manila	May 3rd, 1898 ...	...
San Thomé-Loanda... ...	„ 4th, 1898 ...	May 14th, 1898
Monte Video-Rio Grande ...	„ 5th, 1898 ...	...
Havre-Waterville	„ 10th, 1898 ...	May 17th, 1898
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Cartagena-Barranquilla ...	July 4th, 1896 ...	...
Saigon-Bangkok	May 13th, 1898 ...	May 17th, 1898

The Telephone Service.—According to the *Daily Chronicle*, it is proposed to hold a conference of representatives of local authorities on the subject of the telephone system, in view of the appointment of a Select Committee of the House of Commons to inquire whether the telephone service should be undertaken by municipal and other local bodies. The Highways Committee have invited the local authorities of London to appoint representatives to attend at the County Hall on Thursday, May 26th, to confer with them as to the needs of London as regards the telephone service, and as to what suggestions should be offered to the Select Committee with reference thereto.

Mr. Hanbury has been appointed chairman of the Parliamentary Telephone Committee, which is to meet on Tuesdays and Thursdays to take evidence, the first witnesses being officials from St. Martin's-le-Grand. A strong effort will be made to expedite matters, so that the committee may be in a position to report to the House before the end of the present Session.

The "Tutanekai."—An Auckland, N.Z., paper says that Mr. W. C. Smythe, of the Telegraph Department in Wellington, is to accompany the *Tutanekai* during her cable-laying operations, as electrician. Mr. C. May, of Dunedin, left for Wakapuaka at the end of March for the work of laying the new cable across Cook Strait, and subsequently to pick up, repair, and relay the present one. This work was estimated to occupy several months.

The War and the Cables.—The *Standard* special correspondent at Key West says that on Saturday last the cutter *Windom* landed there the six men who were wounded while engaged in the risky operation of cutting the cable off Cienfuegos on Wednesday. Four boatloads of men were sent from the ships to Colorado Point, at the entrance to the harbour, furnished with grapplers for the purpose of hauling up and severing the cable. As they approached the shore a detachment of Spanish infantry opened fire from rifle-pits, assisted from time to time by a machine-gun. The warships at once shelled the pits, and drove most of the Spaniards, it is believed, into the lighthouse. Altogether 175 shots were fired from the men-of-war. The boats' crews suffered rather heavily. The operation of cutting the cable was carried out successfully, and Havana is consequently cut off from Cienfuegos, and Cienfuegos from Santiago, while the junction with the British cable from Jamaica to Halifax, which was previously possible, is now destroyed. Marshal Blanco is also isolated from Madrid and the Western portion of Cuba.

A Washington despatch says that the United States Government proposes to sever all the southern cables from Cuba and to leave only the one from Key West to Havana, which it controls. The reason that the Cienfuegos cables were not cut before is that several Americans and other foreigners were still in that town; but now they have all safely reached Port au Prince.

It is stated that the British cable between St. Lucia and St. Vincent has been cut by the Spaniards in furtherance of their designs against the *Oregon*, the *Marietta*, and the *Buffalo*, now off the mouth of the Amazon. These vessels are thus placed beyond the reach of orders or information from the United States, except such as reach the telegraph points, *vid* steamer, across the severed loop of the cable. That Spain shall get no further telegraphic information is being assured by a stricter censorship, especially over the French line from New York, which has been induced to give a written acceptance of the rules imposed upon it, under the penalty, if found in default, of an instant cutting of the company's cable at Coney Island.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—May 25th. The date for the receipt of tenders for the electric lighting plant at the railway station at Ghent (Gand-Sud) for the Belgian State Railway Authorities has been fixed for May 25th.

Belgium.—May 31st. The Municipal Authorities of Ixelles, a suburb of Brussels, are inviting tenders until May 31st for the exclusive concession for the supply of electrical energy for lighting and power purposes during a period of 26 years, that is, to September 1st, 1924. Tenders to be sent to the Secretariat de la Commune d'Ixelles, Brussels, from whence particulars may be obtained.

Bury St. Edmunds.—June 13th. The Corporation invites tenders for the supply and erection of Lancashire boilers, three 60-kw. steam dynamos, transformer and booster, accumulators, street mains, and various other machinery and apparatus for the electricity undertaking. Consulting engineer, Mr. F. H. Medhurst, 13, Victoria Street, S.W. See our "Official Notices" May 13th.

Coventry.—June 7th. The Electric Lighting Committee invites tenders for electric mains, switchboards, arc lamps, posts and apparatus in connection therewith. For particulars of the several sections see our "Official Notices" May 13th. Mr. Gilbert S. Ram, city electrical engineer.

Dublin.—May 23rd. The Corporation wants tenders for the supply of high tension feeders and low tension distributors laid and jointed complete on a solid system, not including road work, but including the connecting up of existing consumers to the new mains. Also for transformers (20 to 50 kw., about 700 kw. in all) with instruments and apparatus in sub-stations erected and fitted complete. Particulars at the office of the city engineer; or from Prof. Kennedy, 17, Victoria Street, S.W. See our "Official Notices" May 6th for particulars.

Glasgow.—May 21st. The Corporation is inviting tenders for the excavator and concrete works of the new generating station to be erected at Port Dundas. Architect, Mr. A. Myles, 143, West Regent Street, Glasgow.

Hammersmith.—June 8th. The Vestry is inviting tenders for the supply and erection of a Ledward evaporative condenser and tanks, air pump, circulating pumps, and pipe work. Consulting engineer, Mr. A. H. Preece. See our "Official Notices" for particulars.

London.—June 21st. The London County Council is inviting tenders for engines, dynamos, accumulators, switchboards, feeders, distributors, and service mains and all accessories, to be fixed complete in buildings at the Crossness Outfall Works, near Erith, Kent. The L.C.C. also requires tenders for providing and fixing cables, wires, conductors, casing, pendants, brackets, and other fittings, columns, lanterns, lamps, switches, and switchboards, distributing boards, fuses, cut-outs, &c., necessary for the lighting by electricity of the Crossness pumping station and works, near Erith, Kent. Particulars of both contracts from the Engineer's Department, County Hall, Spring Gardens, S.W. See also our "Official Notices" this week.

Russia.—May 27th. Tenders are being invited by the Municipal Authorities of Odessa for the concession for the construction and working of three lines of electric tramways in the town, the total length being about 39 versts. Particulars may be obtained from La Mairie d'Odessa, Russia, to whom tenders are to be sent.

Southampton.—May 23rd. The Corporation is inviting tenders for the necessary trenching and laying of conduits for electric mains in various thoroughfares. Particulars from the Town Clerk, Municipal Offices.

Spain.—May 28th. Tenders are being invited by the Municipal Authorities of Plencia (province of Vizcaya) for the concession for the electric lighting of the public streets of the town. Tenders to be sent to El Secretario del Ayuntamiento de Plencia (Vizcaya) from whom particulars can be obtained.

Sunderland.—May 27th. The Corporation invites tenders for the supply of steam and other piping, and water softener for the electricity works. Borough electrical engineer, Mr. J. F. C. Snell. See our "Official Notices" May 13th for particulars.

Victoria.—June 24th. The Council of the city of Hawthorne (Colony of Victoria, Australia) is inviting tenders for the supply and erection of buildings, boilers, engines, dynamos, transformers, mains, meters, arc lamps, poles; also running the plant for three years. See our "Official Notices" March 11th.

CLOSED.

Aberdeen.—The Gas and Electric Light Committee last week considered the tenders sent in for laying the necessary cables for the extension to the harbour and the West End. The offers sent in were as follows:—The Western Electric Company, £14,318; W. T. Glover & Co., £13,113; Callender's Cable Company, £12,642; British Insulated Wire Company, £12,405; and Messrs. Siemens Bros., £12,138. The Messrs. Siemens' offer, being the lowest, was accepted. Powers are to be applied for to borrow an additional £20,000.

Bethnal Green.—On Tuesday, at the meeting of the Bethnal Green Guardians, the following tenders were received for the installation of the electric system in their new infirmary, which will be the most complete in the metropolis:—Messrs. Speedy & Co., £6,659; Cox Walkers, £9,920; W. B. Scott & Co., £8,671 8s. 5d.; G. E. Cockburn, £8,741; Sharp & Piper, £6,460; Thames Ironworks Company, £9,321; Paterson & Cooper, £6,992; Nicholson & Tyler, £7,921 6s. 7d.; H. F. Joel & Co., £7,920 14s.; Private Wire and Telephone Installation Company, £8,919; Calvert & Co., £4,965; National Electric Free Wiring Company, £7,631; Richmond Engineering Works, £5,840 10s.; H. C. Keen & Co., £7,775; Cash, Robinson & Co., £8,100: Crompton & Co., £8,223; Laing, Wharton and Down, £7,272; Hampton & Sons, £6,837; H. J. Rogers & Co., £7,125; Troup, Curtis & Co., £7,192; Brush Electrical Engineering Company, £6,958 10s. The tender of Messrs. Calvert & Co., the lowness of which was freely commented upon, was unanimously accepted. Messrs. Giles & Gough, of Charing Cross, are the architects.

Bootle.—Last week on the recommendation of the Watch Committee, the following tender of the British Insulated Wire Company, Limited, Prescot, was accepted in accordance with the specification prepared by Mr. T. L. Miller, electrical engineer for the borough:—65 10-ampere arc lamps with lamp-posts, incandescent lamp brackets, lamps, and other accessories, at £25 5s. 3d. per lamp; and seven 10-ampere arc lamps, with suspending wires and other accessories, at £19 18s. 9d. per lamp.

Colwyn Bay.—The District Council last week accepted the tender of Mr. Bertram Thomas for £1,469 for electric lighting on the parade. The following is a list of the tenders sent in, reproduced from the *Contract Journal*:—

	Gas plant.	Steam plant.
Eckersley & Co., Manchester	£1,971	£2,101
B. Thomas, Manchester (*accepted)	1,469*	1 589
British Insulated Wire Company, Prescot	1,507	1,589
Calvert & Co., Manchester	1,306	1,415
Smith & Co., Southport	1,398	1,418
Siemens Bros. & Co., Westminster	1,723	1,833
Sharp & Piper, Westminster	1,684	1,784
H. J. Mills & Co., Salford	1,684	1,807
Lea, Son & Co., Shrewsbury	1,870	2,008
Laing, Wharton & Down, London	1,661	1,764
Brook, Hirst & Co., Chester	1,510	1,627
Crompton & Co., Limited, London	1,635	1,707
Donnison, Barber & Co., Manchester	1,590	1,611
J. Maxwell & Sons, Dundee	1,490	1,584
J. Lomax, Kendall & Co., Manchester	1,769	1,864
G. Hill & Co., Manchester	1,522	1,654
Rhodes, Webster & Co., Bradford	1,431	1,591
Wallsall Electric Company, Wallsall	1,545	1,648
Belshaw & Co., Chester	1,904	2,084
W. Lucy & Co., Oxford	1,472	1,699
Donnison, Berlyn & Co., Liverpool	1,474	1,599
Lightfoot Bros., Manchester	1,425	1,541
J. Haynes & Co., Limited, Liverpool	1,577	1,751

France.—The French Post and Telegraph Authorities have just divided a contract for 139 kilometres of electric cables between the three following firms:—Messrs. De la Malrie & Co., of Gravelles-St. Maurice (Seine); the India-Rubber and Gutta-Percha Company, of Persan Beaumont; and M. A. Grammont, of Port de Cheruy.

London.—The London County Council Asylums Committee reported on Tuesday having accepted at £16,665 the tender of Edmundson's Electricity Corporation, Limited, of Westminster, for the electric lighting of the Heath Asylum, Bexley.

London.—The Private Wire and Telephone Installation Company have received orders from the Metropolitan Asylums Board to supply and fit an installation of telephones, fire alarms, and electric bells at the Grove Hospital, Tooting; and telephones at the North Eastern Fever Hospital, Tottenham. The same company has also instructions to fit the New County Hospital at Wakefield with telephones, electric clocks, and electric bells, for the West Riding County Council of Yorkshire.

Shoreditch.—At the meeting on Tuesday evening the Vestry considered the following tenders for the supply of cables for the arc light extension:—Messrs. W. T. Glover & Co.; Messrs. Siemens Bros.; Henley's Telegraph Works, Limited; The British Insulated Wire Company, Limited; Callender's Cable Company, Limited; The Western Electric Company, Limited; and Messrs. Witting Bros., Limited. The tender of Messrs. Glover & Co., for supplying cable under a five years' guarantee, was accepted at the following rates:—

		Including laying and jointing.	Delivery only.
		s. d.	s. d.
·023	High tension twin cable	1 6 per yard	1 3
1·0	Low " "	10 1 "	9 9
·75	" " "	7 11 "	7 7
·5	" " "	5 4 "	5 1
·33	" " "	3 9½ "	3 6½
·25	" " "	3 1 "	2 10
·16	" " "	2 2 "	1 11

The Vestry also considered the following tenders for the supply of arc lamps and fittings:—

	£ s.
Messrs. Oliver & Co.	1,988 8
The Brockie-Pell Arc Lamp Company	2,046 0
Messrs. Johnson & Phillips	2,053 18
Messrs. Crompton & Co.	2,110 0
Messrs. Lucy & Co.	2,834 0
Messrs. Bergtheil & Young	2 832 0
Blahnik Arc Lamp Company (exclusive of carriers)	1 570 0

The tender of the Brockie-Pell Arc Lamp Company was accepted. The Vestry received the following tenders for supplying and fixing an electrically driven fan in the engine room:—

	£ s. d.
Messrs. Pickup & Co.	69 0
The Blackman Ventilating Company	80 10 0

The tender of the Blackman Company was accepted.

Walsall.—The Electric Lighting Committee has accepted the tender of Messrs. Thomas Parker, Limited, to supply and erect an additional transformer for £558.

Waterloo.—The Council has given the contract to Messrs. Waring & Gillow, Limited, of Liverpool, for an electric light installation at the Town Hall.

FORTHCOMING EVENTS.

1898.

Friday, May 20th, at 10.30 a.m.—Second day of the Federated Institution of Mining Engineers at Burlington House, Piccadilly. Paper by Mr. W. T. Goolden, on "Coal Cutting by Machinery." Mr. W. Dixon's paper on the "Latest Developments and the Practical Application of Alternating Multiphase Machinery for Electric Power Transmission" will be open for discussion.

Saturday, May 21st, at 11 a.m.—Institution of Electrical Engineers. Students' visit to the works of the Electric Welding Company. Applications to join the party should be made at once to the Students' Hon. Sec.

Monday, May 23rd, at 8 p.m.—Society of Arts. Fourth and final Cantor lecture on "Electric Traction," by Prof. Carus Wilson:—Case when the final speed is not given—Design for covering a given distance in the shortest time for a given current—Time curves—Effect of using driving-wheels of different diameters—Design for covering a given distance in a given time, with the least possible expenditure of energy—Influence of the weight of the motor on the economy—Advantage of gearing—Example—The Chicago Metropolitan Elevated Railroad.

Wednesday, May 25th, at 7.30 p.m.—Institution of Civil Engineers. Students' Annual Dinner, Sir Douglas Fox in the chair, Restaurant Frascati.

Thursday, May 26th, at 9 p.m.—Conversazione at the Institution of Civil Engineers.

At 8 p.m.—The Institution of Electrical Engineers at the Society of Arts, John Street, Adelphi, W.C. "The Design of Electric Railway Motors for Rapid Acceleration," by Prof. Charles A. Carus-Wilson, member.

Friday, May 27th, at 5 p.m.—Physical Society, Burlington House. Agenda, "A Simple Interference Method of Reducing Prismatic Spectra," by Mr. E. Edser and Mr. Butler. "Some further Experiments on the Circulation of the Residual Gaseous Matter in Crookes Tubes," by Mr. Campbell Swinton.

At 9 p.m.—Conversazione at the Institution of Civil Engineers.

NOTES.

Presentation.—The employés of the Edison and Swan U.E.L. Company, Limited, and Altrincham Electric Supply, Limited, were entertained on Thursday evening at supper by Mr. Cowan, their late manager, and Mr. Still, who has been associated with him for many years, on the occasion of their leaving the firm. The gathering was a great success, and the men, having drunk prosperity to the Edison-Swan Company, presented Mr. Cowan with a handsome silver bowl, and Mr. Still with a massive cigarette box, both suitably inscribed. The presentation was made by Mr. Fawcus, director of the company, on behalf of the men, who all very heartily wished Messrs. Cowan & Still every success in their new venture as manufacturers of electrical specialities.

Appointments.—Mr. E. Garcke, managing director of the British Electric Traction Company, Limited, informs us that the following staff appointments have been confirmed by the board of directors :—

Mr. George Stevens (late town clerk of Hyde).	has been	appointed	Secretary
Mr. C. H. Dade	,,	,,	Assistant secretary.
Mr. G. Walmsley (late secretary of the company)	,,	,,	Accountant.
Mr. Stephen Sellon, Assoc.M.Inst.C.E.	,,	,,	Parliamentary engineer.
Mr. C. H. Gadsby, Wh.Sc., M.I.E.E.	,,	,,	Contract engineer.
Mr W. Howard Smith (late engineer on the construction of Lynton and Barnstaple Railway, and formerly city engineer, Carlisle)	,,	,,	Permanent way engineer.
Mr. H. M. Sayers (late engineer to Madrid, Oporto, and Bournemouth Electric Light Stations)	,,	,,	Power engineer.
Mr. T. B. Goodyer (late traffic manager of Birmingham Tramways)	,,	,,	General traffic superintendent.
Mr. J. A. Lycett (late clerk to the Kingswinford Rural District Council). Address: Wollaston, Stourbridge	,,	,,	Superintendent for Birmingham district.
Mr. J. Vincent Kitchener, (formerly secretary of the company). Address: 19, York Place, Oxford Road, Manchester	,,	,,	Superintendent for Manchester district, including the Potteries.
Mr. D. F. Sugrue (late manager of the Swansea Tramways Company). Address: Tramways Depôt, St. Helens, Swansea	,,	,,	Superintendent for South Wales District.
Mr. Frank B. Lea ...	,,	,,	Superintendent for Glasgow district, and *(pro. tem.)* for Newcastle district.
Mr. W. Gumbley, Assoc.M.Inst.C.E.	,,	,,	Superintendent for Midlands and Eastern Counties district.

Except where otherwise stated, the headquarters of the staff are Donington House, Norfolk Street, Strand, London, W.C.

The Parliamentary Electrical Committee.—Substantial progress was made on Monday, according to the Yorkshire *Daily Post*, by the Joint Committee of the House of Lords and the House of Commons which has been considering the question of electric light generating stations. Considerably more than half the chairman's draft was passed under review, and the main principles upon which electric light companies are to be allowed to work settled. The Committee, in the portion of the report dealt with, hold that the proved public advantages of electrical energy warrant the granting to undertakers of compulsory powers for acquiring sites for generating stations, and lands or easements for mains and pipes and other works. Provision, in their opinion, should be made for the granting of these powers in the provisional orders of the Board of Trade, subject to confirmation by Parliament. Procedure by private bills should be reserved, as at present, for exceptional cases. The powers indicated, it is suggested, may be given either to local authorities or to incorporated companies, whether the incorporation be by special Act or under the Companies Acts. With respect to liability for nuisance the Committee are of opinion that where the site for a generating station is acquired under compulsory powers, and is specified in the provisional order or special Act, the undertakers should not be subjected to any further liability than that which is imposed by the common law in the case of persons exercising statutory powers and duties. On the other hand, where the site for a generating station is acquired by agreement the Committee think the undertakers ought to be subject to the liability imposed by the common law. With respect to notices, they think that the existing practice as to notices to the local authorities, and also to owners, lessees, and occupiers of land, should be followed. As to notices in gazettes and newspapers no amendment of the existing law is suggested. Subject to these observations the Committee are of opinion that compulsory powers for the acquisition of land for a generating station may be properly given where the proposed site is not within the area of supply. The local authorities along the trunk lines, it is suggested, should have the same notices and the same *locus standi* as if that district were within the area of supply. In the case of powers being given for the erection of a generating station outside the area of supply the Committee think that powers may properly be given for laying the mains in streets leading from the generating station to the boundaries of the area of supply. It is also thought that the local authorities should not have a veto against the erection of overhead wires excepting in the case of the London County Council, the City Corporation, and the larger municipalities throughout the country.

A Cable Tramway Condemned.—Colonel Yorke has recently reported to the Board of Trade on the subject of the Cliff Railway at Constitution Hill, and a copy of the report was before the Swansea Council last week. In his report Colonel Yorke described the line, and said that from tests made in his presence he did not consider that the slipper brakes, which would have to be relied upon in case of the cable breaking, could be relied upon to pull up a heavily-loaded car, especially when the rails were wet or greasy. On the other hand, the grip brake, though powerful enough, was not sufficiently rapid in its application, and the speed might increase to a dangerous extent before this brake came into play. There were other features in the tramway to which objection might be taken. The fact that it had been laid as a single line necessitated the use of automatic switches at the crossing place. These switches must necessarily be uncontrolled, and any ignorant or mischievous person or child could push the switches over into the wrong position and cause an accident. Objection is taken to the Y shaped openings running down the hill, and the report continues :—"On looking at the order of 1896, I find that the line is to be laid on an interlacing line, and that the consent of the Board of Trade and of the Corporation is required if any alteration in this method of construction were desired. Had the line been laid as an interlacing line no switches would have been required, and no opening in the conduit such as I have described would have existed. I am unable to find that the Board of Trade have ever been asked to approve of the construction of the tramway as a single line. For this reason and because of the objectionable features inseparable from the use of a single line, and also on account of the insufficient control over the cars (1) by the engine, (2) by the brakes, which form sources of danger not only to passengers by the trams, but to the public using the thoroughfare, I do not consider the line in its present state suitable for public traffic, and I am unable to recommend the Board of trade to grant a certificate to the company."

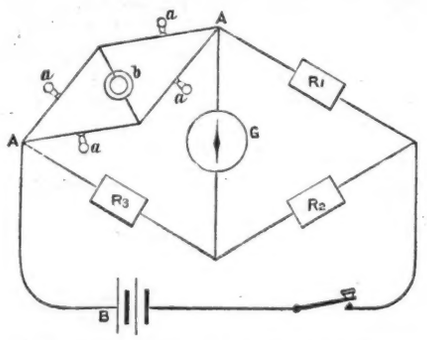
Personal.—Mr. Roland S. Portheim, of Messrs. D. Bruce, Peebles & Co., engineers, Leith, has just concluded a six weeks' tour in the States, where he has inspected many of the electrical manufactories and electrical power installations, more especially those dealing with transmission of power in mills and factories.

We understand that on Thursday last Mr. Henry Wilde, F.R.S., whose name is so well known as that of one of the pioneers in electrical work, was elected an honorary member of the Institution of Electrical Engineers.

Appointment.—We understand that Mr. A. Bentley, A.I.E.E., who went out to South Africa three years ago, has been appointed "electric wiring engineer" to the Johannesburg City Council, at £400 per annum. Mr. Bentley was formerly with Mr. Shoolbred.

Range Finder.—We understand that the Fiske range finder, of which we reproduced a description last week from the *Scientific American*, is made by the Western Electric Company, of Chicago and London.

Measuring the Resistance of Incandescent Lamps.—To those who like unnecessarily complicated ways of electrical testing the method of measuring the resistance of incandescent lamps when lit, described in the *Revue d'Electricité* of March 26th, may be interesting. The authors, MM. Abt and Hoffmann, content neither with taking the ratio of the reading of a voltmeter across the terminals to that of an amperemeter in series with the lamp, nor with a plain bridge test, arranged the test shown in the figure. Four lamps, *a*, *a*, *a*, *a*, are arranged in a quadrilateral



with the battery, *b*, for keeping them alight connected across the diagonal. If the lamps are of equal or proportional resistances, the potentials at A A will be the same. If not, additional resistances are arranged to make the two equal. Then the resistance between A A is measured by connecting R_1 R_2 R_3 to form another quadrilateral with A A and the testing battery, B, and galvanometer, G, connected to complete a Wheatstone's bridge. Then the measured resistance of A A gives the mean of the four lamps, *a*, *a*, *a*, *a*. The whole forms a pretty example of conjugate conductors in a complicated network, and suggests examination problems, but seems poor practice.

The Wright Wave Motor.—An interesting description of the Wright wave motor appears in the New York *Electrical Engineer*. This motor is one of the latest of a long list, which so far has been one of considerable failure. Tests were made in January, 1897, and were encouraging enough to warrant a new wharf and pier extending 350 feet out to sea, and carrying three floats with machinery on the wharf. The floats rise and fall with the waves, and operate vertical hydraulic compressors, which force water into a large air pressure tank, whence it issues as jets upon Pelton motors driving dynamos. The water is simply used over and over again. The tank acts as an equaliser from wave to wave. The present small plant has been running an electric generator continuously since September last, and when enlarged, a transmission line will be built to Redondo, four miles distant, and not far from Los Angeles. A table is given of the results of a public test, extending from December 1st to 11th. The number of waves per minute varied between 3 and 8 on the different days, according to the weather, averaging about 5½. The piston travel varied from 12½ to 18½ feet per minute, both the extremes being, on stormy days, averaging 15½. The average daily tank pressure varied between 150 and 195 lbs., and each float discharged an average of 3·9 cubic feet per minute, and 2·1 H.P. at the Pelton wheel. These figures represent a fall of about 24 gallons of water through a height of 370 feet. The result was nine electric lights kept going. The apparatus is self-regulating to a very large extent, any excessive air pressure tending to counteract the float movement. There is thus steady and continuous working within the limits of the plant.

New Fellows of the Royal Society.—Among the candidates selected by the Council of the Royal Society we observe the name of the Hon. C. A. Parsons, for his invention of the compound steam turbine, which he has adapted successfully to dynamo driving and other uses, and for his recent application of it to marine propulsion. Mr. James Wimshurst is also selected for his electrical influence machines and improvements therein, to which we refer at length on another page.

Corea.—The United States Consul-General at Seoul, Corea, reports as follows, according to *Trade and Industry*: "A company has been formed in the city of Seoul for lighting the streets and residences with electricity, and for operating electric street railroads through the principal thoroughfares. Only the latter will be begun at once. The company, known as the Seoul Electric Company, is composed entirely of Coreans, with the governor of the city as president. They have an exclusive franchise from the Department of Public Works."

Presentation.—Mr. Cassells, late superintendent of mains under the Glasgow Corporation, who has now entered the contracting business, was presented with a handsome testing set by the officials of the electricity department at a smoking concert held a few days ago.

Technical Education.—The Coatbridge Town Council has agreed to give £100 towards the teaching of metallurgy, electricity, &c., in the Technical School, from the local taxation grant, provided a similar sum is given by the County Council.

Correspondence.—Pressure upon our space compels us to hold over until next week a letter from Messrs. Zeitz regarding the "Limerick Electric Tramway Proposal," and one from Mr. E. K. Scott on "Testing Magnet Steel in Bulk."

Appointments Vacant.—The Corporation of Londonderry invites applications for the post of electrical engineer at £160 per annum. See our "Official Notices" this week for particulars.

The St. Pancras Vestry Electricity Committee wants an inspector of works. See our "Official Notices" this week.

The Glasgow Scheme.—We understand that the Corporation on Wednesday approved the minutes of the Electricity Committee, which embodied Mr. Chamen's large extension scheme which we gave briefly a few weeks ago.

The Telephone Committee.—We are compelled, owing to pressure upon our space, to hold over until next week our report of Tuesday's and yesterday's proceedings before the Parliamentary Telephone Committee.

NEW COMPANIES REGISTERED.

British Illuminating Company, Limited (57,260).—Registered May 7th, with capital £50,000 in £1 shares, to adopt an agreement with Smith's Acetylene Gas Lamp and Generator Syndicate, Limited, to manufacture, sell, and deal in calcium carbide acetylene gas generators, and to generate, sell, and deal in acetylene gas, coal gas, and electricity. The subscribers (with one share each) are:—G. Sandeman, Colinton, Midlothian, gas engineer; F. B. Taylor, 25, Mulgrave Terrace, Gateshead, accountant; P. Gilham, 27, Edward's Road, Whitley, Northumberland; J. A. Rowell, 10, Chester Crescent, Newcastle, agent; J. F. Kelly, 51, Doncaster Road, Newcastle, clerk; G. Robson, 64, Rothbury Terrace, Heaton, Newcastle, engineer; T. E. C. Green, 1, Poppelwell Terrace, Preston, North Shields, agent. The number of directors is not to be less than five nor more than nine. The first are H. Coates, N. Wyld, F. H. Smith, and D. J. Adler; qualification, £100; remuneration as fixed by the company. Registered by Jordan & Sons, Limited, 120, Chancery Lane, E.C.

J. Tylor & Sons, Limited (57,279).—Registered May 10th, with capital £200,000 in £10 shares (10,000 £5 per cent. cumulative preference), to acquire the business of a company of the same name (registered in 1890), to adopt an agreement with the said company and its liquidator, and to carry on the business of mechanical and consulting engineers, sanitary, hydraulic, and electrical engineers and contractors, brass founders, galvanisers, platers, tool makers, boiler makers, millwrights, &c. The subscribers (with one share each) are:—W. H. Tylor, 2, Newgate Street, E.C., engineer; J. G. M. Rumley, 43, Palace Court, W., C.E.; W. B. H. Drayson, 2, Newgate Street, E.C., engineer; P. Bright, 2, Newgate Street, E.C., engineer; J. S. Maples, 2, Newgate Street, E.C., engineer; R. Tylor, 2, Newgate Street, E.C., engineer; W. S. Salter, 2, Newgate Street, E.C., engineer. The number of directors is not to be less

than three nor more than five; the first are the first four subscribers. Qualification, £1,000; remuneration, £100 each per annum. Registered by H. & G. Keith, 43, ChanceryLane, W.C.

Automatic Light Controlling Company, Limited (57,287).—Registered May 10th, with capital £10,000 in £1 shares, to adopt a certain agreement, and to manufacture, sell, and deal in apparatus and contrivances connected with electric light or gas, and for controlling and regulating the same. The subscribers are:—J. Gunning, Bournemouth, engineer, 100 shares; J. T. Gascoine, Bournemouth, gentleman, 60 shares; G. H. Rolls, Bournemouth, property agent, 60 shares; C. J. Haydon, Bournemouth, solicitor, 20 shares; Mrs. A. P. Gunning, Bournemouth, 20 shares; E. P. Wills, J.P., Hazelwood, Stoke Bishop, Bristol, 100 shares; E. S. Wills, Frankfort Lodge, Clevedon, Somerset, 40 shares. The number of directors is not to be less than three nor more than seven. The first are: J. Gunning, J. T. Gascoine, G. H. Rolls, C. J. Haydon, and E. P. Wills. Qualification, £200; remuneration as fixed by the company. Registered office, Richmond Chambers, Bournemouth.

British Electric Transformer Manufacturing Company, Limited (57,293).—Registered May 10th, with capital of £50,000 in £1 shares, to adopt an agreement with A. F. Berry for the acquisition of certain British and Foreign patents for electric transformers, and to carry on the business of electrical engineers, electricians, electric transformer manufacturers, iron and brass founders, tool makers, mechanical engineers, boiler makers, &c. The subscribers (with one share each) are:—R. S. Bain, 25a, Cockspur Street, S.W., chartered accountant; R. J. Wallis Jones, 6, Hampstead Mansions, N.W., engineer; T. Petersen, 119, Worple Road, Wimbledon, electrical engineer; A. M. Billington, 7, Porchester Gardens, W., electrical engineer; A. F. Berry, 8, Heathcote Street, W.C., electrical engineer; W. A. B. Clarke, 10, Norfolk Street, Strand, solicitor; A. J. Allum, 25, Princes Road, Notting Hill, W., clerk. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first. Qualification, 500 shares; remuneration, £600 per annum and a percentage of the profits divisible. Registered by W. O. Vizard, 10, Norfolk Street, Strand, W.C.

"Volenites," Limited (57,337). — Registered May 13th, with capital £80,000 in £1 shares, to acquire the secret process and patent rights for the manufacture of "Volenites," to adopt an agreement with H. Bennett, and to manufacture, sell, and deal in oil, guano, volenite, vulcanite, railway sleepers, road and street paving, mats, railway carriage and other wheels, pulley wheels, brake blocks, carriage panels, electrical switchboards, fuse bases, electric bell bases, insulating material, electric motors, &c. The subscribers (with one share each) are: — Lurgan, 21, Lowndes Square, S.W., peer; F. B. Jameson, "The Albany," Piccadilly, gentleman; J. R. Parkington, 6, Devonshire Place, W., major; W. H. Wilson, 36, College Green, Dublin, stockbroker; T. B. C. Hardman, 74, Molesworth Street, Dublin, solicitor; J. K. Rigby, 154, Palmerston Buildings, Old Broad Street, E.C., chartered accountant; H. Fenwick, 95, Vauxhall Bridge Road, S.W., secretary; the number of directors is not to be less than three nor more than seven; the first are, Baron Lurgan, F. B. Jameson, J. R. Parkington, and G. V. Sims. Qualification, £250; remuneration, £200 each per annum, and £250 for the chairman. Registered by H. P. Becher, 26, Bedford Row, W.C.

Drake and Gorham Electric Power and Traction (Pioneer) Syndicate, Limited (57,352).—Registered May 14th, with capital £20,000 in £10 shares, to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity and manufacturers of electrical apparatus. The subscribers (with one share each) are:—B. M. Drake, 66, Victoria Street, S.W., electrical engineer; C. Poston, Highfield Stevenage, Herts, gentleman; C. J. Linas, J.P., Warnham Court, Horsham; G. T. Balfour, 2, Cushion Court, Old Broad Street, E.C., stockbroker; G. J. Poston, 10, Throgmorton Avenue, E.C., member Stock Exchange; J. F. Albright, 66, Victoria Street, S W., civil engineer; A. F. Ashwell, 79, Queen Street, E.C., solicitor. The number of directors is not to be less than five nor more than 15; the first are the first 15 persons who subscribe for 50 shares each; qualification, £500; remuneration as fixed by the company. Registered by Ashwell & Co., 79, Queen Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

South London Electric Supply Corporation, Limited (50,392).—This company's return was filed on April 7th, when the whole capital of £325,000 in £5 shares was taken up. £2 per share has been called, and £131,334 received, including sums paid in advance of calls.

Dover Electricity Supply Company, Limited (39,779).—This company's return was filed on April 14th, when 4,860 shares were taken up out of a capital of £50,000 in £5 shares, and paid for in full.

Norwich Electricity Company, Limited (30,694).—This company's return was filed on March 30th, when 4,565 shares were taken up out of a capital of £50,000 in £10 shares, and paid for in full.

Chelsea Electricity Company, Limited (20,468).—This company's return was filed on April 28th. The capital is £200,500 in 34,000 ordinary and 6,000 preference shares of £5, and 500 founders' shares of £1 each, all of which have been taken up. 6,666 ordinary and 500 founders' shares are considered as paid, and the full amount has been called, and £166,670 paid on the rest.

Direct Spanish Telegraph Company, Limited (6,732 C).—This company's annual return was filed on April 27th. The capital is £95,000 in £5 shares (6,000 preference). 12,931 ordinary and 6,000 preference have been taken up, £5 per share has been called, and £94,655 received.

Sheffield Electric Light and Power Company, Limited (36,551).—This company's return was filed on April 12th, when 14,000 shares were taken up out of a capital of £280,000 in £7 shares; 4,000 have been issued with £5 per share considered as paid, £7 per share has been called on 10,000 and £2 per share on 4,000, resulting in the receipt of £78,000.

Guildford Electricity Supply Company, Limited. (36,725).—This company's return was filed on April 21st. The capital is £20,000, in 3,900 ordinary shares of £5 each and 500 founders' shares of £1 each. 1,542 ordinary and all the founders' shares have been taken up, the full amount has been called, and £8,210 has been paid.

Windsor Electrical Installation Company, Limited (46,186).—This company's return was filed on April 6th, when 20,000 shares were taken up out of a capital of £25,000 in £1 shares. 450 are considered as paid, and £19,550 has been paid on the others. £1 7s. 6d. has been received in respect of 11 forfeited shares.

Gorseinon Electric Light Company, Limited (39,944).—This company's annual return was filed on April 15th, when the whole capital of £1,000 in £1 shares was taken up. 17s. per share has been called, and £843 15s. has been paid, leaving £6 5s. in arrears.

Oxford Electric Company, Limited (34,685).—This company's annual return was filed on April 9th, when 10,000 shares were taken up out of a capital of £100,000 in £5 shares, and paid for in full.

Ogmore Valley Electric Light and Power Company, Limited (34,191).—This company's annual return was filed on April 9th, when 710 shares were taken up out of a capital of £10,000 in £5 shares. £5 per share has been called, and £3,350 received, leaving £197 unpaid.

CITY NOTES.

The New General Traction Company, Limited.

THE meeting of this company, which was postponed from the 12th inst., was held at Cannon Street Hotel on Tuesday, Captain Francis Pavy presiding. The following report was taken as read:—

"At the commencement of the year the two Bills in Parliament referred to in last year's report, viz, the Norwich Electric Tramways Act and the Coventry Electric Tramways Act, received the Royal Assent. In connection therewith contracts have been entered into with responsible and competent contractors to construct both the Norwich and Coventry lines, and the work is being proceeded with as rapidly as possible. To enable the company to carry through these undertakings, the additional preference capital of £100,000, sanctioned at the last annual meeting, was created and issued at a small premium, thus permitting the directors to make contracts in exchange for shares and debentures in the Norwich and Coventry Companies, as provided in the Acts. The section of the Coventry Company already open for traffic has shown results exceeding the board's expectations, and the Douglas Southern Company in the Isle of Man, in which this company is interested, has also given satisfactory results. The gross profits of the year, including £1,681 18s. 11d. reserved last year on account of Bills before Parliament and since recovered, amount to £12,874 2s. 11d., to which must be added the sum of £2,982 19s. 1d. brought forward from last year, making a total amount of £15,857 2s. to the credit of profit and loss. The sum of £2,230 14s. 4d., representing the undivided profit of the old company, and brought forward from March, 1896, the board recommend shall be placed to a reserve account. The board has further decided to charge against the revenue of the year one-half of the cost of the issue of the new capital, amounting to £2,122 12s. 9d. This leaves a balance of £13,734 9s. 3d., from which have to be deducted £3,435 10s. 6d. and £52 15s. 9d. on account of general expenses, salaries, directors' fees, rent, travelling expenses, and legal and other charges, leaving £10,246 3s. as the amount of revenue to be dealt with. A dividend at the rate of 6 per cent. on the preference capital, calculated from the dates of payment, amounts to about £6,500, and the directors recommend that this be paid, and the balance carried forward to next year. Electric tramway business in Great Britain is still far behind that of most other countries in Europe and America, but steady progress is going on in the use of this power, and from the numerous projects submitted, and those now under consideration, the board have every reason to look forward to future profitable business."

The Chairman said that in the report they had tried to set out the facts, and it was no doubt a very satisfactory one. There were one or two things in the history of the company which he should like to mention. Some four years ago his friend Mr. Hopkins conceived the idea that there was room for a company to take up electric traction business, and with a few friends they started a company, which carried out schemes at Coventry and Douglas. So many matters, however, were submitted, that Mr. Hopkins communicated with him (the Chairman) with a view to enlarging the company's sphere. There appeared to be good business in it, and he (the Chairman) was glad to join with Mr. Hopkins in promoting his efforts. They began in a small way, and went on quietly, for they knew if good business could be secured they could put their hands on the capital to carry it out. They succeeded in getting Acts of Parliament for Norwich and for extensions at Coventry. They had been able to issue £100,000 in preference shares, and this was small for the operations they contemplated, but no doubt they would be asking the public for money later on. They regarded it necessary to move with caution, and to secure good business, and they were anxious to work in harmony with the corporations with which they were thrown in contact. It was not the amount of business but the good business which paid them. After referring to the backward state of electric tramways in this country, the chairman said he had no fear for the future. Their gross profits for last year had been £12,874; the undivided profit of the old company, amounting to £2,230, had been placed to reserve, and half the cost of issuing the new capital (£2,122) had been charged against current revenue. A dividend of 6 per cent. on the preference capital had been paid, and the balance would be carried forward.

The report was adopted.

West India and Panama Telegraph Company.

The ordinary general meeting of the West India and Panama Telegraph Company, Limited, was held at Winchester House on Wednesday, Mr. Wm. Andrews presiding.

The Chairman said that the receipts for the half-year had been £32,228, as compared with £34,053, showing a decrease of £2,000. Last year the French cable was interrupted, and that brought extra business; but, on the other hand, the disastrous state of trade in the West Indies, which had recently been intensified, had been an adverse influence. The expenditure had been £19,772, against £21,398 in the corresponding half-year, showing a decrease of £1,626. The reduction was not due to decrease of expenses, but to a smaller quantity of cable being used on the line. Owing to the falling off of receipts it had been necessary to transfer from the reserve fund £1,000 to enable them to make up the difference for the dividend. He apprehended there was no danger in that, seeing the increased value of their investments. With respect to the current period, he was sorry to tell the shareholders that, owing to the financial crisis in Antigua and St. Kitts, the subsidy had been reduced from £800 to £600. Then the subsidy of £2,000 per annum paid by the island of Jamaica had been discontinued from March 31st last, and he believed that the amount would in future go to the Bermuda and Jamaica Company. The shareholders had previously been informed, at the last meeting, of the necessity of a partial renewal of the line between Trinidad and one of the northern islands, so as to maintain the duplication of the system. They had succeeded in saving a certain mileage by the new cable. The Cuba Company had objected to them receiving messages at Jamaica for Eastern stations, and had threatened to take proceedings against them. The directors were advised they had a good case. As to the reductions in their rates, Mr. Chamberlain had made an announcement that the Government would give some support to the West Indies, and the directors, with that statement in view, thought they might also, in a small way, help the West Indies by making a reduction in the price of telegrams, and giving more facilities. He could not state the exact effect of the reductions on the revenue, but the falling off had not been much more than they anticipated, and latterly their revenue had increased, but this was consequent, probably, upon the number of messages sent over their line owing to the lamentable war between Spain and America. In anticipation of interruptions which might take place in their cables, they had taken steps to prevent interference, but in a time of war, as the shareholders knew, private, and sometimes public, interests were bound to go to the wall. They were keeping a ship on the spot in order to keep the system going.

In reply to a shareholder asking if there was still communication with Cuba, the Chairman said he did not want to define too clearly where the line might be interrupted, but they were still going on.

The report was adopted.

Mix & Genest, Limited.

On Monday, May 16th, the annual general meeting of the shareholders of Messrs. Mix & Genest, Limited, of Berlin, was held at their board room at 67, Bulow Strasse, when the directors submitted their report, recommencing a 10 per cent. dividend for the year 1897. The gross profit earned amounts to £25,000, which, after deducting expenses, and writing off £3,200 on tools and machinery, leaves a net profit of £13,570. The chairman informed the shareholders that business has been very brisk during the past year, necessitating a further extension of their newly-built factory, which up to now accommodated 1,000 hands, and which, with the additional premises, will allow of the employment of 1,500 hands. The directors state that the number and amount of Government and trade orders generally in hand are again in excess of last year's figures, and a further development can be prognosticated.

African Trans-Continental Telegraph Company, Limited.

Mr. Cecil J. Rhodes presided at a meeting of this company held yesterday at the offices of the company, 15, St. Swithin's Lane, E.C.

In speaking of the progress made by the company, the Chairman said they had gone from Umtali to Tete, and from Fort Johnson to Bandawe, and in about 15 months they expected to have carried the telegraph line to the south of Lake Tanganyika. They had had great difficulties with the line, and had abandoned the route from Salisbury to Tete, and carried the system from Umtali to Tete. The undertaking had been more expensive than was anticipated, and they had made arrangements with the directors of the Chartered Company to subscribe money to complete the line. They could not expect to make any profit till they got through to Cairo, for he did not think the local returns would pay. General Kitchener would reach Khartoum in October, and then it would be possible to carry their lines to Cairo. From Tanganyika to Uganda was only 600 miles, and from there to Cairo was 1,400 miles, and it was contemplated this could be completed in five years. The system would then enable them to send practically the whole of the African messages to London. If the cable company's charges were too excessive, they could lay an alternative cable. He thought the Government would undertake the expense of joining Khartoum by telegraph, which would not cost more than £120,000. After some further remarks the chairman proposed the adoption of the report, which was seconded by Earl Grey, and carried unanimously.

An extraordinary meeting was then held, when a resolution to increase the capital of the company to £300,000 was adopted.

Hobart Electric Tramway Company.

The report of the directors of the Hobart Electric Tramway Company, Limited, for the year 1897, which was submitted to the annual general meeting held at the registered offices on Friday last, states that the gross takings amounted to £12,380, and the working expenses to £8,853, and after deduction of debenture interest, administration, and other expenses in Hobart and London, the company has made a net profit of £301 for the year. The directors continue to receive assurances that the service provided by the line is much appreciated. The number of passengers carried by the tramway since the opening of the line in September, 1893, to September 30th last is 5,349,450, and the total number of car miles run is 1,336,157. The directors continue to receive from Mr. Parker, the company's general manager in Hobart, very complete weekly and monthly reports as to the working of the company's business, and are glad to be assured by him that the plant and rolling stock remain in an efficient condition.

The City of London Electric Lighting Company, Limited.—Return of gross revenue from supply of electricity only during quarter ended March 31st, 1898:—Gross revenue from public lighting, quarter ended March 31st, 1898, £3,162: corresponding quarter last year (under old rate of charges), £3,182. Gross revenue from private lighting, &c., less allowances to customers under reduced price and sliding scale, quarter ended March 31st, £52,132; corresponding quarter last year (under old rate of charges), £49,843; total, quarter ended March 31st, £55,294; total, corresponding quarter last year (under old rate of charges), £53,025; increase, £2,269. Equivalent of 8-C.P. lamps connected on March 31st, 1898, 310,660; increase during quarter, 14,648. Equivalent of 8-C.P. lamps connected on March 31st, 1897, 260,936: increase during corresponding quarter last year, 13,151.

New Motive Power Company.—A meeting of this company was held on Thursday at the Holborn Viaduct Hotel, but the press were not admitted. The directors' report stated that Mr. Guattari, the inventor, has settled in Belgium, and has failed to keep his promises to return to this country.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending May 13th, 1898, were £2,648 6s. 7d.; corresponding period 1897, £2,288 1s.; increase, £360 5s. 7d.

The City and South London Railway Company.—The receipts for the week ending May 15th, 1898, were £958; week ending May 16th, 1897, £1,000; decrease, £42; total receipts for half-year, 1898, £20,679; corresponding period, 1897, £20,503; increase, £176.

The Dublin Southern District (Electric) Tramways Company.—The receipts for week ending Friday, May 13th, 1898, were £528 0s. 6d.; corresponding week last year, £531 6s. 11d.; decrease, £3 6s. 5d.; passengers carried, 84,256; corresponding week last year, 95,616; aggregate to date, £8,357 17s. 9d.; aggregate to date last year, £8,697 17s. 11d.; decrease to date, £340 0s. 2d.; mileage open, 8 miles.

The Liverpool Overhead Railway Company.—The receipts for the week ending May 15th, 1898, amounted to £1,446; corresponding week last year, £1,352; increase, £94.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending May 13th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £1,985.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, May 11th.	Closing Quotation, May 18th.	Business done during week ended May 18th, 1898. Highest.	Lowest
137,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	...	...	100 104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	7 — 8	7 — 8	...	...
125,000	Do. do. 5% Debs. Red.	100	...	...	...	93 — 96	93 — 96	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 9s.	£2 13s.	3 %	63 - 66	63 - 66	...	...
3,038,020£	Do. do. 6 % Pref.	Stock	£4 18s.	£5 6s.	6 %	113 114	112½ 113½	114	112⅜
3,038,020£	Do. do. Defd.	Stock	...	...	...	15⅝ 16½	14⅝ - 15⅝	16⅜	14½
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	7 %	15⅜ 16½	15½ 15⅝	16	15 9/16
75,000£	Do. do. 5 %, Debs., 2nd series, 1926	100	5 %	...	...	112 116	112 116	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	4 %	4 %	...	3 — 3½	3 — 3½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	8 %	8 %	160 - 170	175 - 185	183	...
918,297£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	2 %	...	3/16 - 7/16	3/16 - 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	7 %	6½ - 7½	7 — 8	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	14½ - 15½	14½ 15½	15½	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 - 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000	50	4½%	4½%	4½%	103 -106%	103 —106%	...	...
60,710	Direct United States Cable, Ltd.	20	2½%	2½%	...	10½ - 11	10½ 10⅝	10⅝	...
120,000	Direct West India Cable 4½% Reg. Deb	100	...	...	...	99 —102	99 —102	...	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	...	17 — 17½	16⅝ - 17⅛	17 1/16	16⅞
70,000	Do. 6 % Cum. Pref.	10	6	6%	...	18 — 19	18 — 19	...	...
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5%	...	100 - 103	100 —103	...	...
1,392,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4%	...	123 —127	123 - 127	125½	125
250,000	Eastern Extension, Australasia and China Teleg., Ltd.	10	7 %	7%	7 %	18 — 18½	17½ — 18	17 1/16	17½
25,200£	Do. 5 % (Aus. Gov. Sub.), Deb., 1908, red. ann. drgs. reg. 1 to 1,849, 3,976 to 4,325	100	5 %	5%	5 %	100 - 104	100 —104	...	...
100,800£	Do. do. Bearer, 1,850—3,975 and 4,327—5,480	100	5 %	5%	...	101 - 104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4%	4 %	127 —130	127 — 130	...	...
35,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1908 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5%	...	100 — 104	100 —104	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5%	...	101 —104	101 —104	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4%	...	102 —105	101 —104	101½	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4%	...	105 —108 %	105 —108	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	4½%	11½ - 11⅝	11½ — 11⅝	11⅝	11½
180,042	Do. do. 6 % Pref.	10	6 %	6%	6 %	16⅝ — 17½	16½ — 17	17	16 9/16
150,000	Great Northern Teleg. Company of Copenhagen	10	10 %	10%	10 %	28½ - 29½	28 — 29	28½	28½
160,000£	Do. do. do. 5 % Debs.	100	5 %	5%	5 %	100 —103	100 - 103	...	...
97,000	Halifax and Bermuda Cable Co., Ltd., 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	97 —102	97 —102	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10%	10 %	50 — 53	50 — 53	51⅞	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6%	6 %	107 —110	107 —110	107½	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000	5	4 %	4 %	4 %	2 — 2⅛	2 — 2⅛	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5⅛%	5⅛%	6 %	5⅝ - 5⅞	5⅝ - 5⅞	5⅞	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜ - 5⅝	5⅜ - 5⅝	5⅝	5⅜
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —104	99 —104	102½	99
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝ - ¾	⅝	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	105 —108	105 —108	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	5 %	8 — 9	8 — 9	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	...	..
58,000	United River Plate Teleph., Ltd.	5	4 %	5 %	...	4 — 4½	4 — 4½	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	105 - 108	105 —108	...	...
15,609	West African Teleg., Ltd., 7,521 to 23,129	10	4 %	*nil*	...	3½ - 4½	3½ - 4½	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	...	...
64,269	Western and Brazilian Teleg., Ltd.	15	3 %	2 %	3½ %	12 — 12½	11⅞ - 12½	12½	12
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	7½ - 8	7½ - 8	7⅞	...
33,129	Do. do. do. Def. Ord.	7½	1 %	*nil*	⅛%	4¼ — 4⅜	4 — 4½	...	...
389,521	Do. do. do. 4 % Deb. Stock Red.	Stock	...	...	...	105 —108	105 —108	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅛%	1 %	⅜%	⅛— ¼	⅛— ¼	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	7½ - 7⅝	7½ - 7⅝	7⅝	7½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 — 7	5 — 7	...	...
80,000£	Do. do. 5 % Debs. Nos. 1 to 1,600	100	5 %	5 %	5 %	105 —108	105 —108	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds	$1000	7 %	7%	7 %	103 —106	103 —108	...	...
160,100£	Do. do. 6 % Ster. Bonds.	100	6 %	6%	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	6 %	7 %	13 — 14	13 — 14	13⅜	...
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6⅜	...
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277	5	5 %	5 %	6 %	9½ - 10½	9 — 10	10½	...
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	115 —117	115 —117	...	...
50,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001— 90,000	10	5 %	7 %	10 %	26 - 27	23½ - 24½	26	24½
10,000	Do. do. Prov. Certs. Nos. 90,001 to 100,000 £5.	10	...	...	...	18 — 19	16 — 17	17½	17
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17½ — 18½	16½ - 17½	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	129 - 134	129 —134	...	...
30,000	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—30,000	10	*nil*	*nil*	*nil*	13½ — 14½	12 — 13	13⅞	12½
10,000	Do. do. do. Nos. 30,001 to 40,000 £4 pd.	10	...	...	...	8½ — 9	6 — 7	8½	6⅞
20,000	Do. do. do. 6% Pref., 40,001—60,000	10	6 %	6 %	6 %	15 — 16	15 — 16	15½	15
17,400	Edmundsons Elec. Corp., Ld, ord. shares 1—17,400 £4 pd.	5	...	...	...	4 — 4½	3½— 4½	...	...
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5			4 %	9½— 10½	9 — 10	9½	9
10,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	11 — 12	11 — 12	...	...
62,400	*Metropolitan Electric Supply, Ltd., 101 to 62,500	10	4 %	5 %	6 %	18 — 19	17 — 18	18½	17
220,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	117 —121	117 — 121	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	2 %	4 %	6 %	19½— 20½	19 — 20	19½	...
31,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord.	5	7½%	10½%	14½%	17½— 18½	16½— 17½	17⅝	16½
20,000	Do. do. 7 % Pref., 20,681 to 40,680	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red.	Stock	...	...	4 %	107 —110	107 —110	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2½— 2⅝	1⅝— 2½	2½	2
79,900	Westminster Electric Supply Corp., Ord., 101 to 80,000	5	7 %	9 %	12 %	16 — 17	15 — 16	16¼	15⅝

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation May 11th.	Closing Quotation, May 18th.	Business done during week ended May 18th, 1898. Highest.	Lowest.
30,000	British Electric Traction	10	...	...	...	15½ — 16½	15½ — 16	...	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 £4 pd. (issued at £2 10s. prem. all paid)	10	...	...	...	7 — 8	7 — 8	...	...
90,000	Brush Elecl. Engng. Co., Ord., 1 to 90,000...	3	2½%	*nil*	*nil*	1½ — 1⅝	1⅝ — 2	1⅛	1⅛
90,000	Do. do. Non-cum. 5 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2¼ — 2½	2¼ — 2½	2 5/16	...
125,000	Do. do. 4½ % Perp. Deb. Stock.	Stock	...	...	...	110 —114	110 —114	113	...
50,000	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	103⅜	...
19,894	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10⅜	10⅜
129,179	Do. do. do. £6 paid	10	...	...	...	6 — 6½	6 — 6½	6¼	6¼
59,254	Do. do. Pref half-shares £1 pd. ...	...	...	...	...	1¼ — 1⅝	1¼ — 1⅝	...	...
67,680	Do. do. Def. do. £5 pd. ...	...	...	...	...	4¼ — 4⅝	4¼ — 4⅝	...	...
630,000	City and South London Railway	Stock	1 1/16%	1 1/16%	1⅛%	67 — 70	67 — 70	70	69½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	...	...	2 — 2½	2 — 2½	2⅛	2
99,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 99,261	5	5 %	5½%	...	2¼ — 2⅝	2¼ — 2⅝	2⅛	...
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5½%	...	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4% Deb. stock Red. ...	100	...	...	...	103 —105	103 —105	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	5 %	6 %	...	2⅝ — 2¾	2⅝ — 2¾	2⅞	2¾
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	...	3⅛ — 3⅜	3⅛ — 3⅜	...	...
111,100	Do. do. 4% Perpetual 1st Mort. Deb. Stock	Stock	...	...	...	106 —108	106 —108	...	...
91,196	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	...	...	...	⅛ — ¼	⅛ — ¼	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	...	...	...	⅜ — ⅝	⅜ — ⅝	...	...
9,600	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	8 %	10 %	12 %	21½ — 22½	21½ — 22½	21½	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21 5/16	21 5/16
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	104⅜	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅜%	2⅜%	3⅛%	10⅝ — 10⅞	10⅝ — 10⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15⅜ — 16¼	15⅜ — 16¼	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	15 %	15 %	35 — 38	35 — 38	36⅜	35½
158,600	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	103	...
540,000	Waterloo and City Railway, Ord. Stock	100	...	...	...	133 —136	133 —136	134	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary £5 (fully paid) 10½.

House-to-House Company, 4½% Debentures of £100, 107—109.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 15½—16½; 1st Preference Cumulative 5 %, £5 (fully paid), 8— 8½. Debentures, 107—110. Dividend, 1897, on Ordinary Shares 10 %.

* From Birmingham Share List.

London Electric Supply Corporation, £5 Ordinary, 3¼—3⅜.

* T. Parker, Ltd., £10 (fully paid), 15½.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

Bank rate of discount 4 per cent. (April 7th, 1898).

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The Prevention of Interruptions to Electricity Supply. By Leonard Andrews, Associate. Read May 5th, 1898.

It is probable that some central station engineers will remark, on reading the title of this paper, that it is several years behind the times; that interruptions to the supply from a properly equipped modern station never now occur; that at their own particular stations the supply has never once been interrupted since it was started, &c.

It speaks volumes for the progress of electrical engineering during the past few years that there are several existing central stations that can show an absolutely clean sheet in this respect since their commencement, and everyone will agree that their engineers hold a very enviable position. It is very doubtful, however, if any of them can say that they have not a consumer connected to their mains who has during the past 12 months ever had his supply disconnected; and, if that is so, surely there is still sufficient room for improvement to make the matter worth discussing. After all, it is these local interruptions that are so irritating to consumers. Our experience has been that we get far more abuse from a consumer whose lights fail when his neighbour's lights are burning satisfactorily than we do if they are both suffering together.

Some of the engineers who have achieved such an excellent record attribute their immunity from failures to the fact that they use fuses made of copper of the same sectional area as the mains. There can be no doubt that a large majority of the interruptions that do occur are caused by fuses blowing when they have no business to do so. Yet it does seem rather risky to use no safety devices at all. We have already heard of more than one case where an arc of a few thousand horse-power has been started under the pavement, and would not be quieted until the supply had been switched off from the works. On the other hand, when one remembers upon what a number of fuses the continuity of an average consumer's supply is dependent, it is really wonderful that he is not more often left in darkness. It is no exaggeration to say that there are often from 15 to 20 fuses between the generators and the lamps they supply. Is it, then, to be wondered at that we are so often told that electricity supply is not to be relied upon? It would be different if we could always depend upon fuses blowing at approximately the current they are set for. But we cannot. It is no uncommon case to take two similar fuses that have been in use for some months and find that one requires about 100 per cent. more current to blow it than does the other. The fuses used on alternate current circuits appear to be particularly erratic in this respect.

The Electrical Review drew attention to this fuse trouble in one of its leading articles a few months ago. Still more recently, Mr. W. B. Sayers, in an article in *Lightning* on the subject, says:—

"In a city less than 100 miles from where I live there is an electricity works which, so far as I am aware, has not failed to maintain its supply for a single minute during the last 4 or 5 years; and yet the popular belief that the 'electric light is not reliable' is maintained to this day, and with good reason. . . . . Now the only proper cause, in my opinion, for a main fuse 'blowing' is a short-circuit on the mains, and yet I have no hesitation in saying that less than 1 per cent. of the cases of main fuses 'blowing' are due to this cause."

The conclusion that we have come to at Hastings is that the only reliable conductor of electricity appears to be a copper cable; and, consequently, it seems advisable to reduce all fuses, switches, safety devices, and mechanical connections of any description to a minimum.

If any fuses that it is customary to use can be omitted, everyone will admit that they are a source of danger, and, consequently, better omitted. Take, for instance, the fuses between alternate-current generators and the bus bars: what are they used for? They cannot be necessary to protect the machines from being overloaded, because all modern makers claim that their machines may be short-circuited with impunity. Presumably they are intended to prevent a generator that fails, short-circuiting other machines working in parallel with it; but everyone knows that if two or three machines of an equal output, and equally fused, are working together, it would be the fuses of the healthy generator that would blow, and not those of the faulty one, because the former have to carry sufficient current to blow the latter, in addition to all the useful work on the mains at the time.

Now what should we think of an omnibus driver who cut the traces of one of his horses because it attempted to do more than its share of the work, or who, when one of them fell down dead, made the remaining horse drag the dead one along in addition to the extra work thrown upon it by the decease of its comrade? This

sounds absurd, but it practically represents the manner in which we alternate-current station engineers have been educated to treat our machines; for are we not taught carefully to equip them with safety devices to cut them out of circuit just at the time when all their energies are required to burn out a short-circuit on the mains? whereas any device to prevent a failing machine from short-circuiting others is considered quite an unnecessary piece of apparatus.

In continuous-current stations zero cut-outs, or discriminating cut-outs, are generally used in preference to excess-current cut-outs—the word "discriminating" being used to designate a cut-out that operates only when the current is flowing through it in a reverse direction to its normal.

Magnetic cut-outs of any description have not hitherto been looked upon with much favour in this country. The majority of those now in use require too careful and delicate treatment to be popular. Only people who have attempted to design a simple and trustworthy discriminating cut-out can realise the number of difficulties that have

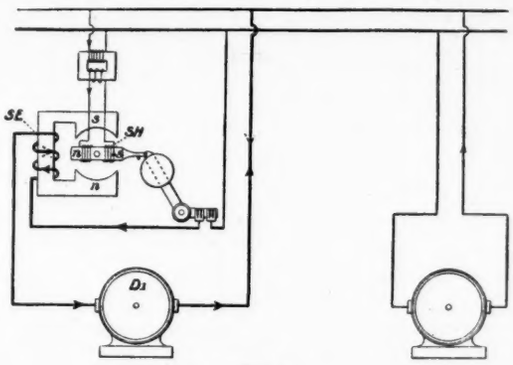


Fig. 1.

to be overcome in doing so. It is easy enough to make an apparatus that will operate under certain specific conditions in the workshops, but it is a very different matter to construct a cut-out that can be relied upon to open the circuit of a failing generator with a very small return current, and that can be guaranteed never accidentally to operate at any time when it is not required to do so. In the first place, the sectional area of the winding must be large enough to carry the maximum current of the generator without undue heating; at the same time the apparatus must be small and compact, consequently the turns must be few; and, finally, it must operate with a return current of only a small percentage of the maximum current, therefore the ampere-turns or magnetising force must be small.

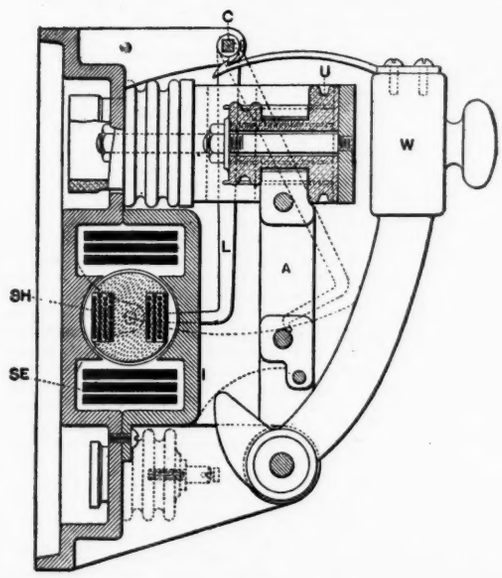


Fig. 2.

This generally involves the use of delicate releasing mechanism or relays, which require careful treatment, or they will operate at the wrong time, and not when a failure occurs. These are only workshop difficulties. The more serious are those which confront us when the apparatus is in use under actual working conditions.

Take, for instance, the case of zero magnetic cut-outs Everyone knows that these can be made to operate only when the current falls below a predetermined amount; and yet it is also well known that if a short-circuit occur on a system of mains supplied by a number of generators equipped with zero cut-outs, several of the generators will be promptly cut out of circuit. This is simply a specimen of the many troubles which it is impossible to forsee and guard against in the manufacturer's workshop.

Between three and four years ago we realised that a reliable discriminating cut-out was badly wanted, and since that time considerably over 100 different combinations of compound windings and releasing mechanisms have been experimented with. Many of these have only reached the experimental stage, but a fair proportion have had several months' actual use under working conditions before some unforeseen difficulty made it necessary to scrap them for some new and improved arrangement. The result has been that we have at last been able to secure a cut-out that appears to be perfect.

It appears at first sight impossible to design a satisfactory discriminating cut-out for use in connection with alternate current machines in which the current is reversing in direction some thousand times a minute. So long as one considers these reversals in relation to a constant polarity, it is, of course, impossible; but as soon as the direction of the current through a particular machine is considered relatively to the direction of the current in all other parts of the system, the problem becomes a comparatively simple one. Fig. 1 illustrates diagrammatically what we have found to be the most satisfactory method of applying this principle. The operating device in this arrangement is practically a shunt-wound motor, the thick

Fig. 3.

winding of which is connected in series with one of the leads from the alternator it is intended to control, and the shunt winding is connected across any transformer excited off the bus bars. Now it is obvious that the direction of the current in the shunt winding, S H, will pulsate synchronously with the current in the bus bars, and will be quite independent of the direction of the current in the series winding, S E, whereas the direction of the current in the latter relatively to the current in the bus bars will depend upon whether the machine to which it is connected is generating current or is being driven as a motor. If both machines are generating current, then the direction of the current throughout the whole system at a given moment will be represented by the arrow-heads shown full. But if, say, alternator D_1 fails, it will tend to short-circuit the rest of the system, and the current will rush back into it in the direction shown by the dotted arrow-heads, whereas the direction

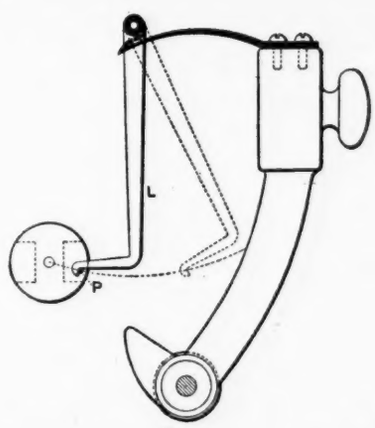


Fig. 4.

of the current in the other circuits will remain the same. In the former case the relative direction of the shunt winding to the series winding in the cut-out device will be such as to tend to make the armature rotate in a clock-wise direction, and so to lock the switch securely; but when, as in the latter case, the direction of the series current relatively to the shunt current is reversed, the armature will rotate in a contra-clockwise direction, and so open the circuit.

Fig. 2 is a sectional elevation of a mechanical application of this principle to a low-tension cut-out suitable for use with continuous-current generators, transformers, and low-tension mains. The weight, W, is held in a nearly vertical position by the catch, C. Attached to the catch is a lever, L, the free end of which engages in a pin projecting from a metal disc on the end of the armature, S H.

The series winding, S E, consists of a few turns of thick copper tape wound directly round the armature. One end of this is sweated and riveted directly on to a brass plate screwed and sweated to one of the contacts, and the other end is sweated on to a thimble, T (fig. 3), which forms one of the series terminals. The other series terminal is screwed and sweated directly on to the second contact. The whole of the series connections and contacts are supported on three corrugated porcelain insulators sulphured into the base. Fig. 3 shows these series connections removed from the rest of the cut-out. This series winding encloses a practically closed double magnetic circuit, consisting of the armature core, a portion of the base, and the cast-iron covers. For alternate-current working these parts are, of course, laminated.

An important feature of this cut-out is the releasing catch. This is shown in detail in fig. 4. The pin, P, is fixed in such a position on the armature disc that an extension of the arc described by the lever, L, will cut the pin, P, and the centre of the armature disc. The result of this arrangement is that no amount of vibration or pressure applied to the weight, W, will tend to make the disc rotate in either direction. And, consequently, when the armature is rotated by a return current, it releases the weight without having first to lift it, as it would have to do with any other form of catch. We find this an absolutely reliable and extremely sensitive form of release.

When the weight, W, is released it falls through an angle of about 60°, then with a sharp blow it strikes the arm carrying the contact connecting piece, thus overcoming any sticking of the contacts due to a good fit or to corrosion.

A specimen 500-ampere cut-out of this description is shown on the table. You will see that it is so reliable that, even when there is no forward current on to lock it in position, it may be knocked about with a mallet to show that no amount of vibration will release it, whereas it is so sensitive that the pressure of a feather upon the armature will do so.

The same general arrangement without any winding on the armature makes a very sensitive and reliable excess-current cut-out.

(To be continued.)

A Magnetic Balance for Workshop Tests of Permeability. By Prof. J. A. Ewing, F.R.S., Member. Paper read May 12th, 1898.

The author believes that the want is felt of a workshop instrument for making tests, in an easy and rapid fashion, of the magnetic permeability of cast and forged metal for dynamo magnets.

His own permeability bridge,* introduced two years ago, and now somewhat extensively used, allows the B-H curve for a given bar to be determined with very much less trouble than is needed to carry out ballistic tests. For the accurate comparison of one bar with another, throughout a wide range of magnetising forces, the permeability bridge is entirely suitable, and it furnishes as simple a means of performing that operation as can well be had. The author uses it systematically in his own testing, and is thoroughly satisfied with it as a means of determining the B-H curve. But the complete B-H curve is really more than the dynamo builder or the steel founder generally wants to know. For his purpose it would often suffice to find the induction produced by some one (fairly high) value of the magnetising force. That information is a sufficient index of the character of the specimen to allow judgment to be passed on its suitability for use in the field magnets of a dynamo.

These considerations have led the author to develop another testing instrument, which, while it tells less about the specimen than can be learnt by means of the permeability bridge, gives the most useful information in a still more easy way. To use it requires no knowledge of electrical testing, and the results need no working out. The value of the magnetic induction, in the usual units, corresponding to a single stated magnetising force, is directly read off on a divided scale.

The instrument is a magnetic balance of the traction type, making use of the principle already applied in magnetic testing in apparatus designed by Prof. S. P. Thompson, Mr. Gisbert Kapp, and Prof. H. Du Bois. In most apparatus of this kind the specimen has taken the form of a turned bar with a faced end on which the pull due to magnetisation was exerted. In the author's balance this facing of the end is not required, the magnetic pull being exerted between the side of the turned bar and a magnet pole which it touches, and from which it is pulled away. The specimen is a turned rod ¼ inch in diameter, and 4 inches long. It lies across the two poles of a U-shaped electro-magnet, which is excited by a constant current of such strength as to produce a magnetising force in the rod of about 20 C.G.S. units. In one of the poles there is a V notch for the bar to rest in, and the other pole has a slightly convex surface, being curved to form a portion of a cylinder with its axis perpendicular to the direction of the length of the rod. The side of the rod touches this pole at one point only, and the tractive force at this point of contact is the force which is measured. A lever or weigh-beam is applied to pull the rod away from this pole, while the other end of the rod remains in the V notch in the other pole, forming what may be called a magnetic hinge. The tractive force is measured by means of a weight which slides along the graduated weight-beam.

When the rod is put in place, the current is reversed once or twice, to wipe out any residual effects of previous magnetisation. The weight is then moved along the beam until the beam just drops each time it is raised, so as to bring the side of the rod into contact with the pole.

The rod requires no preparation beyond turning it to the proper diameter. Its cylindrically turned side touches the convex pole-face in a perfectly definite manner, and the rod may be taken out and put back without altering the character of the contact. The lever is arranged in such a way that the rod always touches the same point of the pole-face.

The value of the magnetising force to be brought to bear on the rods under test was fixed at about 20 C.G.S. units for the following reasons:—

At forces much weaker than this, the B-H curves of different specimens often cross; in other words, the order of merit often changes when the force is varied. But the author's experience in testing dynamo steel leads him to the conclusion that with forces of 20 units and over, there is no serious change in the order of merit of various specimens. If a piece is good when H = 20, it remains good under stronger forces; if it is only fair when H = 20, it remains only fair, and a specimen that has relatively low permeability under this force does not take a materially better place when the force is increased. On the other hand, any considerably stronger force would be less convenient for testing, especially because the difference between good and bad specimens would become less well marked, and the sensitiveness of the test would consequently be reduced. The author has selected 20 as a force which, on the one hand, is sufficiently low to make the distinction wide between bad and good specimens, and on the other hand, is sufficiently high to make the order of merit substantially the same as is maintained under stronger forces.

From the measured induction at H = 20 the probable induction at higher forces can be inferred with some confidence. By examination of the results of tests of a very large number of samples of dynamo steel, including the published tests of Mr. Parshall,* as well as his own tests, the author has prepared the following table, to show the probable approximate values of B at forces of 25, 30, 40 and 50 C.G.S. units, when the value of B at a force of 20 is known. The values of B found for H = 20 range, in dynamo steel, from 16,000 in the very best specimens, down to 12,000 in specimens of decidedly low permeability. About 15,000 is representative of good dynamo steel castings, and anything below 14,000 may be pronounced poor.

Table I.—Probable Values of Magnetic Induction, B for various Amounts of Magnetising Force, H.

Magnetising force, H.	Magnetic induction, B.				
20	12,000	13,000	14,000	15,000	16,000
25	12,700	13,700	14,600	15,500	16,350
30	13,300	14,200	15,100	15,900	16,600
40	14,200	15,000	15,700	16,400	17,000
50	14,900	15,600	16,300	16,900	17,400

The range of the new magnetic balance extends (for H = 20) from 12,000 up to something over 16,000. It will test at the top of its range the very best samples that are found, and at the bottom of the range it will test steel of poorer quality than would be accepted for use in dynamo magnets.

The scale is a linear one, in which equal divisions correspond to equal differences in B, for a constant value of H. It is graduated to give by direct reading the values of B for H = 20. This uniform graduation is arrived at in consequence of the fact that with different specimens the magnetising force is not quite constant, although the current in the electro-magnet is constant. A specimen of high permeability increases the induction in the magnetic circuit, and consequently causes a larger share of the magneto-motive force to be used in that portion of the circuit which lies outside of the specimen itself. Hence the induction in the specimen is less high than its greater permeability would imply; in other words, the better specimen is exposed to a somewhat less magnetising force than the worse specimen is exposed to. The tractive force increases more rapidly than in simple proportion to the actual induction; but matters are so arranged that the lessening of the induction which comes about in the way just stated compensates for this, and the observed differences of tractive force, as measured throughout the range of the scale, stand in simple proportion to the differences in the values of B which the various specimens would exhibit if the force, H, were constant. In other words, a scale of equal parts on the weigh-beam corresponds to equal differences of B under a constant magnetising force, and the weigh-beam is accordingly lettered to read B directly in equal divisions. The readings give B for H = 20, although, in consequence of the action just explained, the actual magnetising force is barely 20 for rods of very good quality, and somewhat exceeds 20 for rods of lesser permeability. The scale is adjusted by the maker by selecting values of the sliding weight and of a fixed weight on the weigh-beam which will bring the readings into agreement with the known values of B in certain standard rods.

A single standard rod is supplied with each instrument, and the observer adjusts his current until the tractive force on that rod is such that the sliding weight stands at the place on the beam corresponding to the known value of B which a force of 20 C.G.S. units produces in that standard. The standard rod consequently serves instead of an ampere-gauge, and no other current measurer is required. A rheostat is provided in the instrument for regulating the current, and a single small storage cell forms the necessary battery. The observer puts in the standard rod, and turns the rheostat until he finds that the weigh-beam just drops each time it is

* Described in the author's paper on "The Magnetic Testing of Iron and Steel," *Min. Proc. Inst. C.E.*, May, 1896. See also the *Electrician*, May 8th, 1896.

* *Min. Proc. Inst. C.E.*, May, 1896.

lifted, while the sliding weight indicates the known value of B. He then puts in the rod which is to be tested, and finds the position which the sliding weight has to take for it, no change being made in the current. The constancy of the current is checked at the end of the tests by again putting in the standard rod.

The complete instrument is shown in the figure (fig. 1). The weigh-beam lifts the rod by means of a V-shaped stirrup close to the pole-piece, from which it is to be pulled away. When the rod is pulled away the beam comes immediately against a stop which limits the motion. A hinged piece is provided under the far end of the weigh-beam, to hold it up while a rod is being taken out or put in. The weigh-beam can readily be lifted out of the way when it is desired to clean the pole-faces, and care has to be taken to keep them, as well as the side of the rod where it touches them, free of dust and rust.

In the following table a comparison is made, for a number of rods of different qualities, of the values of B known to be produced by a magnetising force of 20 units with the values as measured by this magnetic balance. The known values of B were determined by means of the permeability bridge, by comparing each rod with a standard whose B-H curve had been found in the first instance by ballistic tests. The range covered by these examples is as wide as is likely to be met with in the practical testing of dynamo steel.

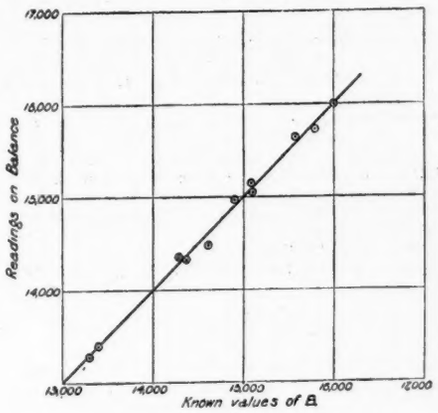


Fig. 2.

Table II.—Calibration of the Balance.

Induction, B, at H = 20, determined from independent measurements.	Induction, B, read from balance.
13,300	13,280
13,400	13,400
14,340	14,360
14,350	14,290
14,600	14,470
14,900	14,960
15,100	15,060
15,080	15,150
15,570	15,650
15,800	15,720
16,000	16,000

These tests relate to different specimens, all tested with one constant current in the magnet of the balance. The agreement between the scale readings and the known values of B is satisfactory. Fig. 2 exhibits the same tests graphically, the readings of the balance being plotted against the known values of B for H = 20. They show that within this range of B the values of the induction (under constant H) are fairly represented by the readings on the uniformly divided scale of the balance. Such irregularities as occur lie equally, so far as can be judged, on both sides of the straight line. The readings of the balance may be accepted as giving values of B for H = 20 at least as accurately as these are required in the uses which the balance is meant to serve.

TRAMWAY BILLS IN PARLIAMENT.*

Aberdeen Corporation Tramways.—To authorise the Aberdeen Corporation to acquire, and the Aberdeen District Tramways Company to sell their undertaking; to empower the Corporation to work or lease the tramways; and for other purposes.

New Capital—by Loan, £150,000.

Blackburn Corporation Tramways.—*Inter alia*, to authorise the Blackburn Corporation to acquire, and the Blackburn Corporation Tramways Company to sell their undertaking; to empower the Corporation to make additional Tramways, to use electrical or any mechanical power, and to work their tramway undertaking.

New Capital—by Loan, £187,000.

New Lines—1 m. 5 chs, double; 3 m. 37 chs., single—Total track, 5 m. 47 chs.

* *Railway World.*

Blackpool and Fleetwood Tramroad (Tramway Extensions.)—To authorise the Blackpool and Fleetwood Tramways Company to construct tramways at Blackpool, to be worked by animal, electrical, or any mechanical power not being steam power; to empower the Company to supply electrical energy in bulk, and to raise additional capital; and for other purposes.

New Capital—by Shares, £75,000; by Loan, £25,000.

New Lines—The part of the Bill relating to extensions has been dropped.

Blackpool Improvement.—*Inter alia*, to authorise the Blackpool Corporation to make additional tramways, to be worked by electrical, animal, or any other mechanical power; and to empower the Corporation to work the tramways.

New Capital—by Loan, £12,500.

New Line—58 chs., double; 2 chs., single—Total track, 1 m. 38 chs.

Bristol Tramways (Electrical Power, &c.)—To authorise the use of electrical or mechanical power on the tramways of the Bristol Tramways and Carriage Company, Limited, and the compulsory purchase of land; and for other purposes.

Bristol Tramways (Extensions).—To authorise the Bristol Tramways and Carriage Company, Limited, to construct additional tramways, and to widen certain streets and roads; and for other purposes.

New Line—6 m. 55 chs., double; 32 chs., single—Total track, 13 m. 30 chs.

Burnley Corporation Tramways.—*Inter alia*, to authorise the Burnley Corporation to work their tramways, if and when they

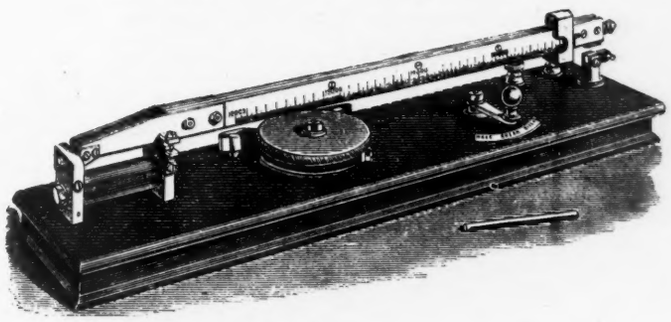


Fig 1.

acquire the tramways authorised by the Burnley and District Tramways Order, 1879, to use electrical or any mechanical power thereon, to generate electricity, and to enter into agreements with regards to the tramways in the Borough of Nelson, the Districts of Padiham and Brierfield, and the Township of Reedley Hallows.

Bury Corporation.—*Inter alia*, to authorise the Bury Corporation to work their tramways, if and when they acquire the tramways in the Borough; and to construct electric works.

Cardiff Corporation.—*Inter alia*, to authorise the Cardiff Corporation to construct tramways; to use electrical and other mechanical power to work their tramways; and to enter into working agreement with certain tramway companies.

New Capital—by Loan, £261,510.

New Lines—6 m. 48 chs., double; 1 m. 69 chs., single—Total track, 14 m. 5 chs.

Clontarf and Hill of Howth Tramroad.—To incorporate the Clontarf and Hill of Howth Tramroad Company; to authorise the construction of tramroads, to be worked by electrical or any mechanical power, except steam power; to confer power to acquire land; and for other purposes.

New Capital—by Shares, £50,000; by Loan, £25,000.

New Line—1 m. 16 chs., double; 4 m. 38 chs., single—Total track, 6 m. 70 chs.

Corporation of London (Foreign Cattle Market) Deptford.—*Inter alia*, to empower the Corporation of the City of London to construct a tramway between the Foreign Cattle Market at Deptford, and the Deptford Wharf Branch of the London, Brighton, and South Coast Railway; to be worked by animal power, or, subject to the approval of the Board of Trade, by electrical or other mechanical power, not being steam power.

New Capital—included with other works. New Line—22 chs., single.

Devonport, Plymouth, and Stoke Tramways.—To incorporate the Devonport, Plymouth, and Stoke Tramways Company; to authorise the construction of tramways, to be worked by animal or mechanical power; and for other purposes.

New Capital—by Shares, £150,000; by Loan, £37,500.

New Line—5 m. 61 chs., double; 31 chs., single—Total track, 11 m. 73 chs.

Dublin Southern District Tramways.—To amend the provisions of the Dublin Southern Tramways Act, 1893, relating to the speed at which engines, carriages, and trucks may be driven or propelled on the Dublin Southern District Tramways Company.

Dundee Corporation Tramways.—To confirm an agreement between the Dundee Corporation and the Dundee and District Tramway Company, Limited, to empower the Corporation to work their tramways; to use electrical or any mechanical power; and for other purposes.

East Ham Improvement.—*Inter alia*, to empower the East Ham Urban District Council to purchase any tramway in their district, upon the terms and conditions set forth in Section 43 of the Tramways Act, 1870, as if the period of years therein stated elapsed on the day of the passing of this Act, and to authorise the Council to use mechanical power, and to work tramways.

New Capital—by Loan, £8,000.

Folkestone Electric Tramways.—To incorporate the Folkestone Electric Tramways Company; to authorise the Company to construct tramways in Folkestone, Sandgate, and Hythe, to be worked by animal, electrical, or any mechanical power, and to acquire land; to provide for the supply of electrical energy by or to the Company; to confer power to enter into working agreements; and for other purposes.

New Capital—by Shares, £200,000; by Loan, £50,000.

New Lines—3 m. 41 chs., double; 9 m. 8 chs., single—Total track, 16 m. 10 chs.

Great Orme Tramway and Tramroad.—To incorporate the Great Orme Tramways Company; to empower the Company to construct a tramway and a tramroad, to be worked by animal, electrical, or any mechanical power, and to acquire land; to confer power to enter into agreements as to supply of electrical or other power by or to the Company; and for other purposes.

New Capital—by Shares, £25,000; by Loan, £6,250.

New Line—Total track, 77 chs.

Halifax Corporation.—*Inter alia*, to authorise the Halifax Corporation to construct new tramways, and to apply certain provisions of the Act of 1897.

New Capital—by Loan, £77,270.

New Line—1 m. 66 chs., double; 10 m. 20 chs., single—Total track, 13 m. 62 chs.

Hastings and St. Leonard's Tramways Company.—To incorporate the Hastings and St. Leonard's Tramways Company; to authorise the Company to construct tramways, to be worked by animal or other mechanical power; and for other purposes.

New Line—2 m. 21 chs., double; 5 m. 1 ch., single—Total track, 9 m. 43 chs.

New Capital—by Shares, £125,000; by Loan, £31,250.

Ilford Improvement.—*Inter alia*, to empower the Ilford Urban District Council to work tramways for the time being belonging to them, and to use mechanical power thereon.

Ipswich Dock Commission.—*Inter alia*, to authorise the Ipswich Dock Commissioners to make tramways, to be worked by locomotive engines, and to enter into agreements with the Great Eastern Railway with respect to working.

New Capital—Included with other works.

New Line—36 chs., double; 37 chs., single—Total track, 1 m. 29 chs.

Keighley Corporation.—*Inter alia*, to empower the Keighley Corporation to maintain a certain existing Tramway; to work their tramways; to use electrical or any mechanical power thereon; and to construct works for generating electricity.

New Capital—Included with other works.

Leyton Urban District Council.—*Inter alia*, to empower the Leyton Urban District Council to work tramways for the time being owned by them within their district, and to use electrical or other mechanical power thereon.

London County Council (Northern Tramways).—To authorise the London County Council to construct tramways in the County of London; and for other purposes.

New Capital—by Loan, £32,000.

New Lines—2 m. 3 chs., double; 6 chs., single—Total track, 4 m. 12 chs.

London County Council (Westminster Bridge and Embankment Tramways).—To authorise the London County Council to construct tramways over Westminster Bridge and along Victoria Embankment, in the administrative County of London; and for other purposes.

New Capital—by Loan, £24,000.

New Line—1 m. 49 chs, double—Total track, 3 m. 19 chs.

London United Tramways.—To authorise the London United Tramways, Limited, to construct additional tramways; to acquire land; and to use electrical or any mechanical power; to confer power as to the supply of electrical energy by or to the Company; and for other purposes.

New Lines—15 m. 4 chs., double; 68 chs., single—Total track, 30 m. 76 chs.

Manchester Carriage and Tramways Company.—To authorise the Manchester Carriage and Tramways Company to use electrical or any mechanical power on their tramways; to enter into agreement as to the supply of electrical power by or to the Company; and to raise additional capital; and for other purposes.

New Capital—by Shares, £100,000; by Loan, £25,000.

Norwich Electric Tramways.—To authorise the Norwich Electric Tramways Company to construct additional tramways and to make street widenings; to apply certain provisions of the Act of 1897; to provide for the purchase of the tramways within and without the City Borough, by the Norwich Corporation, and for the raising of additional capital; and for other purposes.

New Capital—by Shares, £24,000; by Loan, £6,000.

New Lines—14 chs., double; 68 chs., single—Total track, 1 m. 18 chs.

Oldham Corporation.—*Inter alia*, to empower the Oldham Corporation to work their tramways; to use electrical or any mechanical power thereon, and to construct electric works.

Plymouth Corporation.—*Inter alia*, to authorise the Plymouth Corporation to construct an additional tramway; to use electrical or any mechanical power; to construct electric works; and to work their tramways; and to apply certain provisions of the Order of 1893.

New Capital—by Loan, £4,000.

New Lines—35 chs, double.

Portsmouth Corporation.—To empower the Portsmouth Corporation to purchase the tramways undertaking authorised by the Landport and Southsea Act, 1863, to construct new tramways, to use electrical or any mechanical power, to work their tramways, to acquire land, to generate electricity, and to borrow money; and for other purposes.

New Capital—by Loan, £38,300.

New Lines—1 m. 7 chs., double; 1 m. 1 ch, single—Total track, 3 m. 15 chs.

St. Helens Corporation.—*Inter alia*, to authorise the St. Helens Corporation to construct tramways in and near the borough, to use electrical or any mechanical power, to construct electric works, and to work their tramways; to enable the Corporation to purchase or take on lease tramways within or outside the borough; and to empower the Board of Trade in certain cases to make provisional orders for the construction of tramways outside the borough.

New Capital—by Loan, £50,000.

New Lines—72 chs., double; 8 m. 41 chs., single—Total track, 10 m. 25 chs.

West Ham Corporation.—*Inter alia*, to empower the West Ham Corporation to work tramways which they may acquire within the borough, to use electrical or any mechanical power thereon, and to construct electric works.

Wigan Corporation.—*Inter alia*, to authorise the Wigan Corporation to construct additional tramways, to use the electrical or any mechanical power thereon, to purchase tramways authorised by the Order of 1895, to construct electric works, and to work their tramways; and to empower the Abram, Ince-in-Makerfield, and Standish-with-Langtree District Councils to purchase the tramways within their respective districts.

New Capital—by Loan, £38,000.

New Lines—40 chs., double; 5 m. 41 chs., single—Total track, 6 m. 1 ch.

BLAST FURNACE GAS FOR MOTIVE POWER PURPOSES.

A paper on this subject, by M. A. Greiner, was read recently before the Iron and Steel Institute. As this subject has been discussed in previous issues of the Review, it may be interesting if we give an abstract of the paper. The author first referred to the experiments made with an 8 H.P. gas engine at Seraing, and to those at Wishaw, described by Mr. Galbraith in December last. Proceeding, the author said:—A short description of the great 200 horse-power engine at Seraing may be of interest. Gas from the blast-furnace gas mains is led through three pairs of coke scrubbers, 1·5 metres in diameter and 6 metres high (5 feet × 19¾ feet). The coke is washed with water delivered by Koerting spray-producers. The gas passes successively through the two scrubbers of each of the three pairs, and then straight to the engine. It may be sent at will through a gas-holder which is used for testing, or as a reservoir in case of eventualities. The gas-holder is 12 metres (39⅓ feet) in diameter, and has a lift of 3 metres (10 feet). It holds 300 cubic metres (10,600 cubic feet). Gas is drawn through it by a fan driven by an electromotor. The gas engine is of the four-cycle type, with a single horizontal cylinder 800 millimetres (31½ inches) in diameter, and a stroke of 1 metre (39·37 inches). It runs 100 revolutions per minute. The connecting rod works on to a counterbalanced crank shaft. The fly-wheel is 4 metres (13 feet) in diameter, and weighs 15 tons. Compression in the cylinder is carried up to 8 kilogrammes per square centimetre (about 114 lbs. per square inch). Ignition is produced electrically, and is adjustable; the governor is outside, and the whole build of the engine is simple and strong.

It was proposed to utilise this engine for running a belt-driven dynamo for power and lighting purposes, but this will be done with the second engine, and the first will be used for driving an air compressor directly off the main shaft. The air compressed to five atmospheres will be led by pipes to different machines and pumps, which are now driven by steam at the same pressure. A simple cock will enable steam or compressed air to be used at pleasure.

A number of objections have been offered to the use of gas engines driven by blast-furnace gas. The chief of these is the trouble that may arise from the dust carried by the gas. At Seraing the gas from the furnaces is no cleaner than in other places, but rather the contrary.

As regards the impalpable dust carried forward by the gas into the gas engine, no details of its amount are available. According to Mr. Lurmann, of the Gutehoffnungshutte, there remains about two grammes of dust in the washed gas after all possible means of purification. At the Georg-Marienhutte, Osnabruck, an average of 2·91 grammes of dust was found in a cubic metre of washed gas. Round figures of 2 grammes and a 200 horse-power engine using 4 cubic metres of gas per horse-power-hour would give 40 kilogrammes, or 88 lbs. of dust daily. Happily, nearly all this will pass out with the

exhaust, as is shown by the 8 horse-power engine, which ran for four months without necessitating a clean up of the cylinder. All the dust was thrown out in the form of a translucent white smoke. It would be difficult to find gas-fired boilers which had run four months without cleaning. Besides, it is no more requisite to use thoroughly clean gas in a gas engine than it is to use distilled water in a boiler.

The second objection attributes a destructive action to the dust, due to the acid matters, especially sulphuric acid, that it contains. Analysis, indeed, shows sulphuric and phosphoric acids, besides chlorine; but the alkalies and lime also present probably neutralise their effect. It is not necessary to use an inordinate quantity of water for washing purposes, and no corrosive action has been observed in two years. The only part that requires cleaning after a few months is the ignition appliance; but even that shows no sign of corrosion, and it can readily be replaced in a few hours. A comparison with the time taken for cleaning and repairing a boiler and its setting leaves no doubt on which side the advantage lies.

A third objection to the use of blast-furnace gas depends on the irregularity of its composition. This objection is not so serious as it appears. In the first place, the gas engine readily accommodates itself to the variable condition of the gas, and experience has shown that when the gas ignites with difficulty under the boilers, it is not too bad to affect the regular operation of the engines. Even if the furnace is not running well, and the gas becomes non-inflammable, the same inconveniences occur with both boilers and engines. Coal has to be burnt on the boiler-grates, and it would have to be used in gas producers for the engines.

In conclusion, a summary of the advantages accruing from the use of gas may be given. Gas is, above all other means, the most suitable for transmission of power. In a factory where motive power is required at scattered points, there are many advantages in a central producer plant from which gas is led to gas engines at the requisite places. Blast-furnaces are gas producers ready to hand, and when there are two or three together, there is not much danger of very great variations in the quality of the gas. Gas can be supplied with ease under a low pressure, and without appreciable loss by leakage or condensation, to considerable distances. The mains and pipes are simple, light, and economical. Boilers, and the dangers accessory to their use, may be abolished. Gas shares with electricity the advantage of directly giving light, heat, and power, and this alone is sufficient to ensure its use by manufacturers, and its general application in metallurgical works.

THE INSTITUTION OF JUNIOR ENGINEERS.

A numerously attended meeting of this Institution was held at the Westminster Palace Hotel on Friday, May 6th, when a paper on "Evaporative Condensers, and Independent Air Pumps for same," was read by Mr. Harry Fraser, of Millwall, Member. The chairman, Mr. H. Bloomfield Vorley, presided.

In introducing the subject, the author alluded to the increasing field which was opening up for the use of the evaporative form of condenser through the establishment of electric central stations for power and illumination purposes. These stations generally being placed in crowded districts, so as to be convenient for distributing the current, difficulties in obtaining an adequate water supply usually arose where surface condensers were employed. The evaporative condenser, if properly designed, would do its work with a water supply equal to three-fourths of the weight of steam which it condensed, and descriptions of such condensers producing vacuums up to 26 inches were given.

In designing the apparatus, it was necessary to bear in mind the boiling points of water at various pressures less than that of the atmosphere, as, should the water trickling over the outside of the tubes become too hot when nearing the bottom, the condensed water inside would be re-evaporated, and the vacuum destroyed. An arrangement of compound condenser, in which the coldest water was first brought in contact with the coldest part of the condenser and the hottest water against the hottest part, thereby obtaining the greatest possible exchange of temperature between the inside and outside surfaces, was described, and tabulated figures given showing its advantages.

It was of great importance to have all the joints well made, and easily accessible; a very small air leak would seriously affect the working of the apparatus, and the average deposit on the outside of the tubes left by the evaporating water amounting to 25 ounces per square foot per annum, provision for cleaning was most essential. Specimens of the author's devices for cleaning the outside of the tubes, and distributing the steam through the inside of the condenser were exhibited. No fixed condition as to design could be determined, as the spaces available for the erection of the condensers varied through such wide limits. It had been found that horizontal tubes were more advantageous than vertical, but that the space occupied by a condenser with horizontal tubes was larger than that necessary for the erection of a vertical tube condenser. The distance between the condenser and steam engine was of no consequence, provided that due area was allowed in the exhaust pipe and in the air pump suction pipes.

Most of the inventions in connection with evaporative condensers simply dealt with various arrangements for the distribution of the cooling water over the outer surface of the tubes, it being difficult to direct water to flow with an even film over a hot tube. Illustrated descriptions of some of these arrangements were given.

It being necessary that the evaporative condenser should have a much larger surface to do a given amount of work than an ordinary surface condenser, the cost of construction per square foot of surface was an important consideration. As indicating the effect of improvements in construction, it was stated that some of the latest designed apparatus cost about one-half per square foot of surface as compared with earlier ones, without the efficiency of the condenser being impaired. By experiment it had been found that artificial fan draught improved the efficiency of the apparatus by about 50 per cent., and a fan draught was recommended when the load varied to any considerable extent, as then the fan need only be run during the heaviest load.

With a properly designed condenser, the proportions of air pump used for a surface condensing apparatus would be found equally satisfactory with an evaporative plant. The idea that it was requisite to have a much larger air pump for the latter probably arose from some of the earlier condensers having been put up with not sufficient surface to fully deal with the volume of exhaust steam entering them. If the condenser were not large enough, putting in a bigger air-pump would not prove a remedy. Models and designs of the various air-pumps constructed by the Worthington Company, Blake & Knowles Company, Browett & Lindley Company, and others, were exhibited, all of them being of the balanced beam system, which arrangement largely helped to overcome the natural inequality of the turning moment of an independent air-pump.

With reference to the increasing popularity of air-pumps having one set of valves only, and that set being above the piston, the author pointed out that while such an arrangement might work satisfactorily with marine type surface condensers, it was not certain that they would be equally favourable with evaporative condensers; but as his firm were now building two sets on this principle for a 1,500 H.P. plant, he hoped later on to be able to give some more reliable information on this single-valve pump question.

A discussion followed the reading of the paper, in which Mr. A. H. Stanley, Mr. T. C. Morewood, Mr. A. E. Curry, Mr. J. H. Pearson, Mr. R. Marshall, Mr. S. Boulding, and Mr. W. J. Tennant took part. The author having replied, and a vote of thanks having been accorded him, the proceedings then concluded.

THE PARSONS TURBINE PATENT.

In our issue of April 22nd we gave briefly the decision of the Judicial Committee of the Privy Council to extend the Parsons turbine patent for a period of five years.

On Saturday Lord Macnaghten gave their Lordships' reasons. He stated, says the *Times*, the invention which was the subject of the patent was one of conspicuous merit. It had solved a problem which for 100 years and more had exercised and baffled the ingenuity of inventors. Many persons had endeavoured to employ the velocity of steam for the purpose of causing rotary motion without the intervention of any reciprocating apparatus. But no one before Mr. Parsons ever succeeded in producing a steam turbine of practical utility. Mr. Parsons had his attention directed to the subject while he was a student at Cambridge, and he devoted much time and thought to it then. But it was only after prolonged research and many experiments that he was able to determine the conditions of success. Mr. Parsons stated in his specification that motors according to his invention were applicable to a variety of purposes. Practically, however, up to the present time they had been applied only to the two purposes of electric lighting and marine propulsion. For the purpose of electric lighting the invention seemed to be specially adapted. In dispensing with reciprocating action Mr. Parsons got rid of vibration. It thus became possible to establish electrical stations in populous places and to use the most powerful engines there without fear of being stopped by an injunction on the ground of nuisance. As regards marine propulsion, only one vessel so far had been equipped with Mr. Parsons's invention. The success of that experiment had, however (as their Lordships were informed), induced the Admiralty to order two vessels of a similar type, one of which was guaranteed to attain the speed of 35 knots. Lord Kelvin, when examined as a witness, expressed his opinion that there was a great future for steam turbines, and that, for some purposes, Mr. Parsons's invention was likely to supersede the reciprocating type of engines. So far the case was clear. The difficulty began when the question of remuneration came to be considered. It would not be easy under any circumstances to appraise the value of such an invention or to assess even approximately the amount of remuneration which it deserved. The task was not rendered lighter by the circumstance that it was impossible to measure with anything like accuracy "the profits made by the patentee as such." If the invention had been less meritorious, their Lordships would have been disposed to consider that circumstance fatal to the application, as it certainly would have been if the difficulty had been attributable to any fault on the part of the patentee. But their Lordships were satisfied that the patentee's accounts had been fairly kept and fairly presented, and that Mr. Parsons had given their Lordships all the assistance in his power. The general accounts of receipts and expenditure in respect of the English patent, exclusive of its application to marine propulsion, brought a result showing that the total expenditure had exceeded the gross profits by £1,107 13s. 10d., after allowing interest on capital at 7 per cent. per annum, but without charging anything for the patentee's services. In regard to foreign patents corresponding to the English patent, the patentee's accounts brought out a loss of £202 4s. 11d. The Belgian, German, Italian, and Swedish patents were allowed to lapse in the interval between July, 1890, and December, 1893, when Mr. Parsons's patent rights were in the hands of his late partners, from whom they were repurchased in December, 1893, in consideration of £1,500. In September, 1895, Mr. Parsons sold to the

Westinghouse Machine Company, of Pittsburg, the United States and Canadian patents, together with other valuable patent rights belonging to him, but reserved the right to use all the patents comprised in the sale for the purpose of marine propulsion. The consideration was a lump sum of £5,000 and certain royalties in respect of which £850 had been received. The total amount received from the sale, after deducting expenses, was £5,263 18s. 8d., of which one-fifth was attributed in the accounts to the patent No. 6,735, 1884. Even if the whole proceeds of the sale were attributed to the original patent, it appeared to their Lordships that the gain on the foreign patents would not counterbalance the loss on the English patent if any reasonable allowance was to be made to the patentee for his services. The result so far, in a pecuniary point of view, was disappointing. Their Lordships were, however, satisfied that Mr. Parsons had done his best to push his invention. Its slow progress in public favour was in accordance with all experience. New methods were not welcomed by workmen or manufacturers, or even by mechanical engineers. The greater the novelty, the greater the apathy and hostility to be overcome. The circumstances relating to the application of the patent to the purposes of marine propulsion, and the results in the shape of profits attributable to that application, required a more detailed statement. In 1893, Mr. Parsons made numerous experiments in order to test the applicability of steam turbines for marine propulsion. In January, 1894, he granted to the Marine Steam Turbine Company, Limited, an exclusive license to use for marine propulsion only the patent in question, with a large number of others belonging to him. In consideration of that license he received £9,000 in fully paid-up shares in the company, which had an issued capital of £24,000 out of a nominal capital of £25,000, so that Mr. Parsons became interested in three-eighths of the issued capital of the company. In order to demonstrate the effect of steam turbines as applied to marine propulsion, the company built and equipped the *Turbinia*, at a cost of about £16,000. Mr. Parsons executed all the work for the company at net cost, and without making any charge for his own services. When the success of the *Turbinia* was established, a new company, called Parsons's Marine Steam Turbine Company, Limited, with a nominal capital of £500,000, divided into 5,000 shares of the nominal value of £100 each, was formed for the purpose of purchasing from the old company the license which they held from Mr. Parsons, together with the *Turbinia*, and all the tools and effects of the company. The purchase price was £30,000 in cash, and £80,000 in shares, together with certain royalties and certain rights to further shares in the event of further issues of capital. After repayment of the outlay on the *Turbinia*, the sum received in cash by Mr. Parsons in respect of his shares in the old company did not seem to have been more than sufficient to pay him a fair remuneration for his services in connection with the *Turbinia*. The result appeared to be that the remuneration which Mr. Parsons had received for his invention consisted of so much of his interest in the new company and so much of his remaining interest in the old company as might be properly attributable to the patent No. 6,735, 1884. As regarded Mr. Parsons's interest in the old company, he was entitled to certain royalties which no doubt might prove extremely valuable, but from which no profit had hitherto been derived. His shares in the new company, 300 in all, reduced in number by a few shares given by him to his employés, were admittedly of considerable value. Shares in the company were not on the market, and had never been sold. Their Lordships, however, thought they ought to be taken at their par value. The question then arose how much of Mr. Parsons's interest in the old company and in the new company was properly attributable to the patent No. 6,735, 1884. That was a very difficult question. But, having regard to all the circumstances, and having considered the evidence of the gentleman who assessed the value of the patents comprised in the sale to the new company for the purpose of apportioning the price between them, their Lordships had come to the conclusion that the amount should be taken at not more than one-half and not less than one-fourth. Having arrived at that conclusion, considering the position of the new company, bearing in mind that it could not commence operations at the earliest before August next, and that the value of the shares in the new company must depend to a large extent on the prolongation of the original patent, and weighing all the other circumstances of the case, their Lordships were of opinion that Mr. Parsons had not been adequately remunerated, and they would consequently make their report to that effect. They had already intimated that the patent should be prolonged for five years.

NEW PATENTS.—1898.

Compiled expressly for this journal by **W. P. Thompson & Co.**, *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*

10,022. "Improvements in the manufacture of carbons and filaments for electric lamps." G. Daubenspeck. Dated May 2nd.

10,034. "A new or improved primary electrical battery." A. Frazer and G. A. Smith. Dated May 2nd.

10,065. "An electric double-pole fuse plug and combination grid connection." A. Walters. Dated May 3rd. (*Complete.*)

10,089. "Improvements in electric telephony." C. Adams-Randall. Dated May 3rd.

10,094. "Improvements in the art of making plates for electric battery purposes." A. C. Croftan. Dated May 3rd. (*Complete.*)

10,110. "Improvements in electric arc lamps." C. Oliver. Dated May 3rd.

10,121. "Improvements in, and connected with, arc lamps." J. F. Wakelin. Dated May 3rd.

10,225. "An improved method of casting accumulator plates and apparatus therefor." J. Hesse and J. Kernaul. Dated May 4th. (*Complete.*)

10,236. "Improvements in electric arc lamps." W. J. L. Sandy, D. C. Bate, and T. Gebs. Dated May 4th.

10,245. "An improved automatic electric cut-in and cut-out." A. E. R. Bottone. Dated May 5th.

10,248. "Improvements in electrical time checking and registering apparatus." C. Miles. Dated May 5th.

10,269. "Improvements in alternating current induction motors." The British Thomson-Houston Company, Limited. (C. P. Steinmetz United States.) Dated May 5th. (*Complete.*)

10,270. "Improvements in alternating current induction motors." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated May 5th. (*Complete.*)

10,291. "Rheostats for electric circuits." C. Wirt. Dated May 5th.

10,308. "Improvements in appliances for automatically replacing fuses in electric installations for lighting or transmission of power." S Harbison. Dated May 5th.

10,314. "Improvements in, or relating to, electric motors." H. H. Lake. (R Arno and A. Caramagna, Italy.) Dated May 5th.

10,333. "Improvements relating to electric signalling and similar apparatus." L. S. Crandall. Dated May 5th. (*Complete.*)

10,346. "Improved apparatus for automatically cutting off current of electric overhead or other like wires." R. Bostock and F. A. Cheetham. Dated May 6th.

10,352. "An improved magnetic motor engine." E. J. Knight. Dated May 6th.

10,428. "Improvements in electro-therapeutic exercising apparatus." A. Martin. Dated May 6th.

10,437. "Improvements relating to cut-outs and switches for electric motors and other electrical apparatus." G. A. Momer. (H. H. Cutler, United States.) Dated May 6th. (*Complete.*)

10,440. "An improved detachable ceiling rose for use with arc lamps and other electrical apparatus." A. L. Davis. Dated May 7th.

10,450. "Improvements in the construction of dynamo-electric machines and motors." M. W. W. Mackie. Dated May 7th.

10,457. "Improvements in galvanic batteries." E. Habermann. Dated May 7th.

10,475. "Improvement in electrical accumulators." W. Peck. Dated May 7th.

10,477. "Improvements in quick-break switches or cut-outs for electric lines." G. Jaeger, C. Jaeger, and H. Bender. Dated May 7th. (*Complete.*)

10,483. "Improvements in and relating to electrical switches." F. W. Abbott and R. W. Bill. Dated May 7th.

10,496. "A new or improved maximum electric current self-recording instrument." F. M. Staunton. Dated May 7th.

10,511. "Improvements in and apparatus for producing mechanical energy from alternating electric currents." A. Heyland. Dated May 7th.

10,523. "Improvements in apparatus for regulating electric arc lamps." I. H. Hegnar. Dated May 7th. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of **Messrs. W. P. Thompson & Co., 322, High Holborn, W.C.**, *price, post free, 9d. (in stamps).*

1897.

19,035. "Improvements in electrolytic apparatus." H. S. Jones. (E. Balbach.) Dated August 17th, 1897. This consists of a cathode case composed of a trough having its bottom divided in two portions, one of which is horizontal. The other portion sloping down and connecting the horizontal portion throughout its length. It is provided with a cathode plate and an anode suspended therein, arranged to cover the horizontal portion of the bottom only. The anode case is composed of an exterior frame which has a grated bottom, and an inner frame fitting into the exterior case, with a filter cloth bottom. Instead of one anode case there may be a series, arranged transversely side by side. 5 claims.

20,041. "Improvements in metal for telegraph and other poles." G. W. Glazier. Dated August 31st, 1897. This consists of a pole, to the end of which is secured segmental metal base sections, by means of bolts. The lower ends of these sections are made outwardly flaring, and are provided with a series of perforations through which the earth is rammed after these sections have been placed in a cavity in the ground. On the outside of these sections are strengthening ribs which, besides serving to increase the strength, also in a measure conceal and protect the heads and nuts of the fastening bolts. 2 claims.

1898.

3,796. "Improved means for displacing, dispersing, or extinguishing arcs formed in breaking electric circuits." S. H. Short. Dated February 15th, 1898. Relatively stationary co-operating contacts are mounted on the controller of a cylinder and conducting coils comprising spiral convolutions, are arranged in the circuit to be broken adjacent to each pair of contacts. There is a shunt circuit for these coils and contacts controlling the shunt circuit, so that when the controller is in "running" position the coils are cut out of the working circuit and are replaced in circuit in advance of the opening of the circuit. 10 claims.